Fishery Management Plans

2021

Natural Resources § 4-215

Prepared by
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2021 Fishery Management Plan Legislative Report

This document addresses the requirement to regularly report on the status of each managed stock in the Chesapeake Bay and Coastal Bays of Maryland, as required under Natural Resources Article, §4-215, Annotated Code of Maryland. The report consists of a species-specific narrative and a fishery management plan (FMP) implementation table. The narrative contains information on the FMP background, stock status, management measures, the fisheries, and issues/concerns. The implementation table is a synopsis of all the management strategies and actions found in the species FMP, implementation dates, and status of the management actions.

Background

Under the 1987 Chesapeake Bay Agreement and the 1992 Amendments, the Chesapeake Bay jurisdictions developed a series of FMPs for commercial, recreational, and selected ecologically valuable species. The Chesapeake Bay FMPs provide a framework for the Bay jurisdictions to generate compatible, coordinated management measures to conserve and utilize a fishery resource. As ecosystem-based considerations are included in management plans, interactions among species, habitat, land use, and socioeconomic factors become part of the decision-making process thus balancing sustainable fishery yields with conservation goals. Since a large fraction of the managed fish species in the Chesapeake Bay spend a portion of their life history outside the Chesapeake Bay boundaries, fishery management measures must be coordinated on a regional and coastal basis. For coastal migratory species, the federal Mid-Atlantic Fishery Management Council (MAFMC) develops management measures for species mainly found in the Exclusive Economic Zone (EEZ or 3-200 miles offshore). For species utilizing the inshore coastal area (0-3 miles offshore), the Atlantic States Marine Fisheries Commission (ASMFC) defines compliance requirements. The ASMFC requires the states to prepare annual compliance reports for the following species: American eel, Atlantic croaker, Atlantic menhaden, Atlantic striped bass, Atlantic sturgeon, black drum, black sea bass, bluefish, horseshoe crab, Spanish mackerel, red drum, shad and herring, scup, spot, spotted seatrout, summer flounder, tautog, and weakfish. Additional information on stock status and fishery management measures for these migratory fish species can be found at asmfc.org and mafmc.org. Coastal fishery requirements are mandated along the Atlantic coast. The Chesapeake Bay FMPs outline how Chesapeake Bay jurisdictions will implement coastal compliance requirements and identify any additional issues specific to the Chesapeake Bay region. The Maryland Coastal Bays FMPs outline how species are managed in the Coastal Bays. The development of Maryland's Coastal Bays FMPs is part of a larger plan, the Comprehensive Coastal Management Plan (CCMP). The Maryland-specific FMPs (yellow perch, white perch, blue crabs, hard clams, largemouth bass, brook trout, oysters, and catfish) provide a framework for managing species in Maryland waters, some inland and tidal areas.

In addition to the Chesapeake Bay Agreement, Natural Resource Article, §4-215, Annotated Code of Maryland states that the Maryland Department of Natural Resources (MD DNR) shall prepare fishery management plans for a list of species. Once a plan has been developed and adopted, it may be incorporated by reference into the Code of Maryland Regulations (COMAR). A 2010 legislative bill gave MD DNR authority to create fishery management plans without the need to annually amend NR §4-215 to add new species to the list of managed species. The statute requires MD DNR to address overfishing when data shows that it is an issue. The MD DNR also consults with the Tidal and Sport Fisheries Advisory Commissions, the Oyster Advisory Commission, and the Aquaculture Coordinating Council (TFAC, SFAC, OAC, and ACC, respectively) for their input when developing management strategies and actions.

Introduction

Twenty-one fishery management plans encompassing 26 fisheries have been adopted by MD DNR in accordance with §4-215. Fishery management plans are updated on a regular basis to maintain effective management strategies that reflect the changing needs of fishery resources based on recommendations from species-specific biologists, FMP staff, and advisory bodies.

Currently, the process for reviewing FMPs is the annual legislative report. The FABS staff rely on requests from the TFAC and SFAC members regarding which plans may require a more in-depth review. The MD DNR did not receive any requests to complete a more formal review of any of the FMPs during 2021.

During 2017, cownose rays were added to the list of species for the development of an FMP. The original timeline for completion was December 2018 but it was extended to December 2020. A Cownose Ray Workgroup was formed in October 2017. A draft biological background document was completed and approved in 2020. The workgroup met in 2021 to discuss strategies and actions to be incorporated into the FMP. The FMP is currently being developed.

The COMAR allows for pilot programs to evaluate new approaches to managing fisheries (08.02.01.10). Implemented in 2012, the E-Reporting with Fishing Activity and Catch Tracking System (FACTS™) pilot program is a real-time electronic commercial harvest reporting system that provides increased accountability for capturing accurate harvest data. Results, to date, demonstrate that electronic reporting is a viable and verifiable means to report harvest data. Each year since the

study began, the reporting system has systematically been improved. A more specific summary can be found in the Pilot Program section of this report.

Fish Habitat and Land Conservation

The FABS has identified land development as one of the major threats to fish habitat. However, fisheries managers have no authority to regulate land use. To address this challenge, FABS has been working with local governments, environmental organizations, state agencies, and the Chesapeake Bay Program on fish habitat. The central message about fish habitat is "land conservation = fish conservation."

The MD DNR Fisheries Ecosystem Assessment Division has investigated the impact of watershed development on fish habitat and fisheries productivity in Maryland's portion of the Chesapeake Bay Watershed since 2003. Findings generally suggest that as the percentage of impervious surfaces in a watershed increases, fish diversity declines and desirable species become less abundant. Current studies are investigating environmental factors related to anadromous fish spawning, estuarine yellow perch larval distribution, and summer estuarine habitat for juvenile and adult fish communities. This work is funded by federal aid to sportfishing. Information about the program and projects can be found at https://dnr.maryland.gov/fisheries/pages/fhep/index.aspx

A Chesapeake Watershed Agreement was completed in 2014 and the document defined goals and outcomes to restore and protect the Chesapeake Bay. The goals address sustainable fisheries, vital habitats, water quality, toxic contaminants, healthy watersheds, stewardship, land conservation, public access, environmental literacy, and climate resiliency. These goal categories led to the development of specific outcomes, and the development of management strategies to outline what steps to take to achieve the outcomes. Of particular importance to fisheries are the blue crab abundance and management outcomes, the oyster outcome, the forage fish outcome, the fish habitat outcome, the brook trout outcome, the stream health and wetlands outcomes, and the fish passage outcome. The partners of the Chesapeake Bay program regularly review implementation progress on their 2-year work plans that contain specific actions to achieve each outcome. For outcomes that have not been achieved, new work plans were developed for 2020/2021. The most recent information on the work plans can be found at https://www.chesapeakeprogress.com/

Fishery Statistics

The commercial fishery from Maryland waters encompasses more than 30 different species. Licensed commercial harvesters are required to submit trip level harvest information to MD DNR per COMAR regulation 08.02.13.06. Based on harvest information received by MD DNR, the estimated value of commercially harvested fish species from Maryland waters was $95,856,111 in 2021. This is based on non-confidential harvest landings and voluntarily reported dockside values. The realized value is likely greater as, to date, the MD DNR has received approximately 40% to 60% of the required harvest reports, depending on the type of report. These data point to the importance of sustainably managing our fishery resources (Table 1).

Recreational fishing data is collected by the National Oceanographic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) through the Marine Recreational Information Program (MRIP). Recreational data is an important component in assessing the status of fishery stocks. Since 1979, a Coastal Household Telephone Survey (CHTS) has been used to collect data. Following pilot studies, a new mail-based Fishing Effort Survey (FES) was peer-reviewed and certified as a suitable replacement for the CHTS. The FES replaced the CHTS starting in January 2018. Compared to the CHTS historical record, the FES indicates the previous survey underestimated fishing effort. The FES indicates there are three times more effort from private boats than previously estimated and about five times more fishing effort from shore. This does not mean that more fishing is occurring now, but that past estimates did not accurately capture the total estimated fishing effort. As a result, estimated total recreational catch is higher. The MRIP developed a calibration model to convert the historical effort estimates to the new mail-based FES. These new estimates of recreational effort and catch continue to be used in stock assessments and may result in changes to management measures. Further information can be found at https://www.fisheries.noaa.gov/recreational-fishing-data/fishing-effort-survey-research-and-improvements#why-we-made-the-change-to-a-mail-survey-from-a-telephone-survey.

Through the Modern Fish Act, NOAA Fisheries also received additional money to support improved recreational data collection and the Atlantic coast received $900,000 to improve the precision of harvest and release estimates. Through this funding, the number of Access Point Angler Intercept Survey (APAIS) site assignments conducted in Maryland increased by 291 assignments annually. This increase in the number of sampling assignments began mid-year and will cover the full year starting in 2022. Further information can be found at https://www.fisheries.noaa.gov/feature-story/states-receive-3-million-improve-recreational-fisheries-data-collection

Pilot Programs

The COMAR allows for pilot programs to evaluate new approaches to managing fisheries (08.02.01.10). Implemented in 2012, the E-Reporting with Fishing Activity and Catch Tracking System (FACTS™) pilot program is a real-time electronic

commercial harvest reporting system that provides increased accountability for capturing accurate harvest data. It was initiated in response to the 2008 Federal Fisheries Disaster for Chesapeake Bay blue crabs, declared by the National Oceanic and Atmospheric Administration (NOAA). Led by the Blue Crab Design Team, a partnership of MD DNR and industry, the pilot program was developed to help prevent future blue crab fishery disasters. The MD DNR continues to partner with the following organizations for the development and management of the program: Oyster Recovery Partnership, Electric Edge Systems Group, and Versar, Inc.

The web-based electronic reporting system is dependent on hailing, where participants use their own mobile device (smartphone or tablet), phone, or personal computer to report their daily commercial harvest activity. The user only hails on days when they expect to engage in commercial harvest activity; the default for the system is the assumption that no commercial harvest activity is taking place. When a harvester starts a trip in FACTS™, they are alerting the system to expect a harvest report at the end of the day. This 'start hail' is sent prior to leaving the dock, and includes information on where and when they expect to land their harvest. The trip 'end hail' is their harvest report, and is sent before they land their catch. This system provides the opportunity for dockside monitors to verify harvest, and provides enforcement the ability to verify reporting compliance.

The use of independent dockside (roving) monitors early in the program demonstrated that the hailing system improves accountability, paving the way for continued program expansion. This random and unannounced sampling was done when participants landed their catch at the time and location indicated by their hailing activity. Due to the receipt of additional NOAA grants, future years reporting will include dockside monitoring for newer pilot modules. The increased accountability inherent with this pilot program also provides opportunities to offer specific harvest flexibilities for watermen and are allowed under the authority of the pilot program regulations (COMAR 08.02.01.10). As recommended by the Blue Crab Design Team, participants in the FACTS™ pilot program are able to use a flexible day off for crabbing, rather than be constrained to the traditional declared Sunday or Monday; with an early start option for crab potters added in 2020. As the program has expanded, additional flexibilities have been added for striped bass, Atlantic menhaden, yellow perch, charter, and shellfish fisheries.

Important aspects of the FACTS™ pilot program are outreach and support for our volunteer program participants. Training support is provided by the E-Reporting Outreach Coordinator and program partner, Oyster Recovery Partnership. In the last five years, there has also been an increased number of experienced program participants mentoring new users in the use of the system. This training support from industry members is an important part of the program's success as a commercial reporting option. In addition, an introductory series of videos is available in the FACTS™ system and on the program's homepage. This additional source of training reinforcement is part of a convenient online training option for recruits, enhancing program accessibility.

To ensure the pilot program is available to all commercial watermen, the system is designed to work using smartphone/computer technology, and has operators staffing a 24-hour call center. Feedback is received and incorporated throughout the year and additional customer service is provided by the program's 24-hour helpline. Compared to monthly paper reports, electronic reporting is a versatile business tool that provides participants with 24/7 access to their trip and harvest data.

In addition to supporting commercial watermen and program managers, FACTS™ now provides Enforcement level accounts with additional features to more effectively enforce reporting requirements and monitor fishing activity. An online training program specifically for enforcement accounts is available and training on the system has been mandated by NRP leadership for all officers, including recent academy graduates. The Natural Resources Police Communications Operators (PCO) have FACTS™ accounts and have been trained, so that they can support officers in the field with real-time trip data, pilot program permit status, and license information. This will support interpretation of the data being reported and provide guidance for enforcing the program's best reporting practices. The enforcement accounts provide fisheries managers an avenue to communicate regulation changes by public notice directly to officers in the field. Feedback from officers using the system indicates the potential for trip hail information to be used as a float plan to assist watermen during extreme situations. It is important to note that while the Natural Resources Police (NRP) has access to information about real-time fishing activity, reported landings data remain confidential, and require a subpoena to access. The E-Reporting with FACTS™ program continues to work closely with NRP leadership to ensure effective communication of all system and program updates.

The pilot program adapts to the needs of new user groups, supports increasing numbers of participants, and assists in monitoring quota-managed fisheries. What was initially developed as a better way for commercial watermen to submit accurate,

verifiable, and enforceable harvest data has become much more. It is now an important real-time fisheries management **resource** for MD DNR, a business tool for industry participants, and a way for enforcement officers to streamline their efforts to ensure compliance and maritime safety.

FACTS™ 2021 Summary

In 2021, the number of blue crab program participants increased from 14% (n = 747) to 15% (n = 826) of the commercially licensed crabbers in Maryland. Over the course of the season, April 1 through December 15, a total of 11,885 trips were reported in FACTS™ by 392 active crabbers. Roving monitors were not active during the 2021 season due to grant limitations.

Over the last seven years, the FACTS™ program has been expanded to include finfish, charter, and shellfish reporting. The first addition was in 2015 when the striped bass fishery was added. This module for the pilot included the ability for harvesters to do electronic transfers of their quota shares, check-in at certified check stations in real-time (paper quota share cards no longer required), and offered special harvest flexibilities to allow next day check-in of harvest or to have an authorized representative check-in the fish on the same day of harvest. Starting in 2016, all Chesapeake Bay finfish harvest could be reported by FACTS™ users. The Charter Pilot module was added in 2020, and on October 1, 2021 the new Shellfish Pilot (harvesters and dealers) was launched.

In 2021, 16% (n = 407) of the total finfish fishery participated in the program, reporting 1,181 trips by 101 active finfishers in the system. This real-time harvest data is available to MD DNR fisheries biologists and managers. Their access to the system allows them to quickly assess the harvest impact for species of concern. Maryland's landings of American eels represent a significant portion of coastwide eel harvest. In 2021, the commercial eel fishery reported more than 19% of their catch using FACTS™, up from 15.5% in 2020.
Of the total Maryland commercial Atlantic menhaden harvest in 2021, the proportion reported by FACTS™ users increased significantly from 36.5% to more than 50%. Atlantic menhaden harvested from a pound net must be reported to the MD DNR on the day of harvest by text message or online form. Participants in the FACTS™ pilot program are exempt from the additional reporting condition as their routine daily trip activity already meets the reporting requirement.

Since its addition to the pilot in 2016, the yellow perch fishery has been an example of how important real-time reporting can be for both industry and fishery managers when the majority of a fishery participates in the program. During the December 1, 2020 through March 31, 2021 season, the proportion of the fishery using the real-time reporting system decreased from 91% to 80%. Due to the hailing component, the MD DNR was able to accurately assess the daily fishing pressure and manage closings based on known effort. This resulted in the decision to take a less conservative approach to managing fishing effort; allowing more time for watermen to harvest up to the full quota for each of the three designated areas (Chesapeake Bay - North, Chester River, and Patuxent River).

The charter pilot launched on May 1, 2020 and quickly grew to include a majority of the fishery. The active recruitment support of the charter associations and the program flexibility allowing two striped bass to be kept per charter angler (approved under the striped bass conservation equivalency proposal submitted to the Atlantic States Marine Fisheries Commission), led to a significantly higher number of individuals participating than the fifty initially set as the program's goal. By the end of the 2021 season on December 31, 2021 a total of 368 individuals were permitted in FACTS™ to participate in the charter pilot program, reporting 14,001 trips. Roving monitors were active for random landing intercepts and as onboard observers throughout the season.

Charter harvest reporting is linked to vessels, and with FACTS™ both owners and non-owners (operators captaining for vessel owners) run trips and are permitted in the program. Prior to the pilot, the extent to which vessel owners had operators run trips for them was not documented. This means that not only is the vessel and harvest information now being reported in real-time, but the captain running the trip is also identified; making it possible to more completely assess the scope of the fishery. During the 2021 season, there were 309 active charter vessels and 352 captains reporting as part of the entire Maryland for-hire fleet. As defined by its grant, the FACTS™ Charter Pilot Program was developed for those vessels and captains operating within Maryland's portion of the Chesapeake Bay. As a result, comparative participation numbers are based on the 289 vessels active in the Chesapeake Bay and its tributaries. Of the 289 vessels active in the Chesapeake Bay, 255 were listed as being part of the pilot program and reporting their harvest using FACTS™ (n = 88%). With a total of 352 captains reporting charter activity in Maryland waters, 329 of them were Chesapeake Bay operators; of those, 290 were permitted as participants in the Charter Pilot Program (n = 88%).

Of significance in 2021 was the October 1 launch of the new Shellfish Pilot. This included both oyster and clam harvest reporting with the added benefit of a linked dealer pilot program. As demonstrated in the established pilots, electronic reporting for shellfish harvest is expected to ease the burden on both the industry and the MD DNR staff for the submission and processing of paper reports and buy tickets (dealers). During the pilot development process, each fishery has unique issues that are identified for special focus. For the shellfish pilot, a better understanding of harvest areas, such as harvesting oysters off established bars or identifying active clamming areas as they shift, will be monitored closely during the initial stages of the pilot, allowing both industry and MD DNR to benefit from timely, accurate, and verifiable shellfish harvest reporting.

One of the lessons learned from the rapid growth of the Charter Pilot was how the sudden shift of a majority of a fishery to the FACTS™ program impacts comparisons with previous data sets. The real-time data provided by participants in the program is more comprehensive (e.g. additional catch dispositions reported) and the percentage of the fishery reporting data is significantly higher than what was reported on paper; which can have months/years of lag-time. To avoid this issue with Shellfish Pilot data, and to accommodate staff resource limitations, participation in the first year of the pilot was capped at no more than one hundred permittees. By December 31, 2021 there were 31 participants in the Shellfish Harvester Pilot and three dealers participating in the Shellfish Dealer Pilot.

The standard commercial wild shellfish seasons (oystering October 1, 2021 through March 31, 2022 and clamming September 1, 2021 through August 31, 2022) extend past the term covered for this report. As of December 31, 2021 a total of 809 trips were taken by participants. Since clam harvest activity is primarily in the early spring, no trips for clam harvest (hard, soft, and razor) were reported during the term of the report. Those participating in the Shellfish Harvester Pilot were able to sell their harvest to any certified Maryland seafood dealer. The three dealers permitted in the Shellfish Dealer Pilot issued a total of 64 buy tickets through the FACTS™ system. Roving monitors were active for random landing intercepts throughout the season.

As with the established Blue Crab Pilot, the new Shellfish Harvester Pilot offered the option for a specific early start time harvest flexibility. Program permittees licensed to harvest shellfish in the Chesapeake Bay were able to start harvesting up to 1/2 hour before sunrise in the month of March 2022 by electing to daily report using FACTS™ as part of their start hail for each trip. Participants using the early start flexibility observed the same total hours workday as non-FACTS™ users. To ensure enforceability, the system's early start time query for the Enforcement user interface was expanded for the new Shellfish Pilot. This enabled law enforcement field officers to monitor the Shellfish Harvesters Pilot's early start time harvest regulations. Reporting results for the early start time will be included in the 2022 Pilot Program Summary.

The FACTS™ program continues to grow, both in participation numbers (all modules) and enhanced system functionality. Feedback from program participants and input from fisheries managers are reviewed throughout the year. Updates to the system are made as soon as testing is completed. In the next year, further review of the Shellfish Pilot early start harvest flexibility, which had been for March only, will determine if that option will be offered for the full 2022 to 2023 season. It is anticipated that starting September 1, 2022 the Shellfish Pilot program will be expanded for availability to all authorized Maryland oyster and clam harvesters.

Table 1. List of finfish and shellfish species reported as being harvested commercially during 2021.

AMBER JACKS	HAKE - ATLANTIC - RED OR WHITE	SHARK - SHARPNOSE
BASS - STRIPED	HORSESHOE CRAB (MALE)	SHARK - SHORTFIN
BLUEFISH	JOHN DORY	SHARK - SPINNER
BONITO	KINGFISH	SHARK - THRESHER
BUTTERFISH	LINGCOD	SHEEPSHEAD - ATLANTIC
CARP	LOBSTER - AMERICAN	SKATE
CATFISH - BLUE	MACKEREL - ATLANTIC	SNAKEHEAD - NORTHERN
CATFISH - BULLHEAD	MACKEREL - SPANISH	SPOT
CATFISH - CHANNEL	MENHADEN - ATLANTIC	SQUID
CATFISH - FLATHEAD	MINNOWS	SUCKERS
CATFISH - WHITE	MONKFISH	SUNFISH OR BLUEGILLS
CLAM - RAZOR	MULLET - BLACK OR SILVER	SWELLFISH
CLAM - SOFT	MULLET - WHITE	SWORDFISH
COBIA	OPAH	TILEFISH - BLUELINE
CONCHES	OYSTER - EASTERN	TILEFISH - GOLDEN
CRAB - BLUE	PERCH - WHITE	TILEFISH - SAND
CRAB - JONAH	PERCH - YELLOW	TILEFISH - UNCLASSIFIED
CRAB - RED	POMFRETS	TRIGGER FISHES
CRAPPIE	PORGY	TUNA - ALBACORE
CROAKER	RAY - COWNOSE	TUNA - BIGEYE
DOLPHINFISH	RIBBONFISH	TUNA - BLUEFIN
DRUM - BLACK	SCALLOP - SEA	TUNA - YELLOWFIN
DRUM - RED	SEA BASS - BLACK	TURTLE - SNAPPING
EEL - COMMON	SEA TROUT - GRAY	WHELK - CHANNEL
EEL - CONGER	SEA TROUT - SPOTTED	WHELK - KNOBBED
FLOUNDER - SUMMER	SHAD - GIZZARD	WHITING
FLOUNDER - WINTER	SHARK - DOGFISH - SMOOTH	
GARFISH	SHARK - DOGFISH - SPINY	

2021 Maryland FMP Report (December 2022)
Section 1. American Eel (*Anguilla rostrata)*

The Atlantic States Marine Fisheries Commission (ASMFC) implemented Addendum V to the Interstate Fishery Management Plan for American Eel on January 1, 2019. This Addendum established a new coastwide cap of 916,473 pounds (lbs) and removed the state-by-state quotas.[1] In 2021, preliminary U.S. harvest was 394,727 lbs, 54% above 2020 harvest, yet 57% below the coastwide cap.[2] Per Addendum V, no management measures will be necessary in 2022.

Since the American eel stock was determined depleted after the results of the 2012 coastal stock assessment, management strategies through Addendum III and Addendum IV were developed to reduce mortality. They included an increase in the commercial minimum size, gear restrictions, seasonal closure, and recreational size and creel limits. A stock assessment update was completed in 2017. Neither reference points nor stock status could be quantitatively determined in either 2012 or 2017. Stability was noted in coastwide landings and in the Mid-Atlantic population. However, significant downward trends remained in the Hudson River and a few South Atlantic indices and the overall conclusion remained the American eel population in the assessment range was depleted.[3] A new American eel benchmark stock assessment was initiated in 2020 and is scheduled for peer review and completion in fall of 2022.

American eels have a unique life history strategy. Eels spawn in the Sargasso Sea (east of the Bahamas and south of Bermuda) and their larvae (called leptocephali) are carried by currents for approximately one year along the entire Atlantic coast from Central America to Greenland. As the larvae approach the continental shelf, they change into glass eels, which actively swim to coastal areas. After approximately 2 months, the glass eels become pigmented and are referred to as elvers. The elvers either remain in estuaries or continue their migration to rivers and streams. They continue to grow into larger, immature yellow eels and spend most of their life in this stage. Their final life stage occurs when yellow eels become sexually mature and change into silver eels. Mature silver eels then migrate back to the Sargasso Sea to spawn and die. Silver eels can range in age from 3 to 15 years in Maryland and can live up to 30 years in the northernmost latitudes. American eels comprise one panmictic population, i.e., they are a single-breeding population with random mating. They occur in a broader array of habitats than any other fish species. Their complex life history makes the American eel population difficult to assess and a challenge to manage.

American eels provide a unique ecosystem service as they are a primary host for freshwater mussel larvae and are the primary means of mussel dispersal within a river/stream.[4] Mussels provide important ecological services as water filters in freshwater. Providing fish passage so American eels can move into freshwater habitat will facilitate the rebuilding of freshwater mussel populations.

Fishery Management Plans (FMPs)

A Chesapeake Bay American Eel Fishery Management Plan (CBAE FMP) was adopted in 1991. The goal of the CBAE FMP is to manage the American eel population in the Chesapeake Bay and its tributaries, so that harvest does not exceed the natural capacity of the population to maintain its size from year to year. The CBAE FMP was reviewed in 2014. The Plan Review Team concluded that the CBAE FMP management framework is still appropriate for managing the population in the Chesapeake and Coastal Bays but recommended the development of an amendment. In 2016, Amendment 1 to the CBAE FMP was adopted by reference into Maryland regulations. This amendment formally adopts the guidelines and management requirements established by the ASMFC. It also updates the status of the eel resource and provides a framework for managing and monitoring the eel fishery in Maryland waters.

The ASMFC adopted a coastwide FMP for American Eel in 1999. The goal is to conserve and protect the American eel resource to ensure its continued role in the ecosystem while providing the opportunity for its commercial, recreational, scientific, and educational use. The ASMFC developed the FMP to address data needs and to assess other information indicating the decline of some segments of the American eel population. Jurisdictions are required to implement fishery-independent young-of-the-year (YOY) monitoring surveys and to complete an annual compliance report.

Since the coastal FMP was developed, five addenda have been adopted. Addendum I (2006) to ASMFC's FMP required implementation of a commercial licensing and reporting system for American eel fisheries to collect catch and effort data. Addendum II (2008) recommended stronger regulatory language by state and federal agencies to improve upstream and downstream passage at dams, particularly for emigrating silver eels. Addendum III (2013) and Addendum IV (2014) were adopted with the goal of reducing mortality of glass (Maine and South Carolina only), yellow, and silver eels. Addendum III management measures included an increase in the commercial minimum size, gear restrictions, seasonal closure, and recreational size and creel limits. Addendum IV established a coastwide commercial catch cap for the yellow eel fishery, triggers for the implementation of state-by-state commercial quotas, and a quota for the glass eel fishery.[5] Addendum V (2018) increased the yellow eel commercial cap to correct the historical harvest, established a new management trigger, and removed state quotas. Actions will be triggered when the

coastwide cap is exceeded by 10% in two consecutive years. Only those states that harvest more than 1% of the total yellow eel landings will have to adjust their management measures if the trigger is met. Addendum V was implemented January 1, 2019. Provisions for the aquaculture of glass eels were slightly modified. The limit for glass eel harvest for use in domestic aquaculture activities with an approved state management plan is 200 lbs.[1]

Stock Status

The ASMFC conducted a benchmark stock assessment for American eel in 2012. Data from the Atlantic coast indicated that trends in regional yellow eel abundance indices have been variable. For example, the Hudson River and South Atlantic indices indicated decreasing abundance, no trends were evident in the Delaware Bay/Mid-Atlantic Coastal Bay indices, and there has been relatively stable abundance in the Chesapeake Bay. As a whole, the stock assessment models identified declines in abundance for YOY (elver) and yellow-phase American eels. The prevalence of declining indices resulted in a determination that the coastal American eel stock is depleted. The depleted status is attributed to the synergistic effect of harvest pressure, reduced habitat availability (river/stream blockages), increased habitat impairment (pollution), introduction of a swim bladder parasite, and climate change.[6] In 2017, a stock assessment update was completed. Neither reference points nor stock status could be quantitatively determined. Despite stability in coastwide landings and the Mid-Atlantic eel population, significant downward trends were noted in the Hudson River indices and a few South Atlantic indices. The trend analysis supported the conclusion that the American eel population in the assessment range was similar to the 2012 assessment results. The overall stock remains *depleted*. To date, climate change considerations have not been included in stock assessments. However, updated information suggests that North Atlantic Ocean currents and habitats are changing. Physical oceanographic processes have been linked to the abundance and recruitment of juvenile American eels making them vulnerable to climate change.[7]

The U.S. Fish and Wildlife Service (USFWS) conducted an in-depth status review of eels and published a 12-month finding (October 2015). The finding concluded that the American eel resource is stable and does not need protection under the Endangered Species Act (ESA).[8]

Chesapeake Bay biological reference points for American eel have not been established and stock status in the Bay remains unknown. However, based on fishery dependent and independent surveys completed under the Maryland Eel Population Study, yellow eel indices of abundance have indicated positive trends and increases in abundance since the late 1990's. The index developed from the young-of-year glass eel survey in Maryland's Coastal Bays has indicated stable abundance since survey inception in 2000. In addition, significant increases in landings from 2010-2018 without notable changes to fishing mortality further supports the increased abundance trends in Maryland's portion of the Chesapeake Bay.[9,10]

Current Management Measures

Glass eel and elver fisheries are prohibited in Maryland. In 2014, the commercial and recreational minimum size limit was increased from 6" to 9." There is no harvest limit for the commercial fishery but beginning on January 1, 2014, there was a seasonal closure instituted from September 1 to December 31 for all gears except spears and baited eel pots. The recreational creel is 25 eels per person per day. As of January 1, 2017, eel pots are required to have a minimum mesh size of ½" x ½".

Under Addendum V (August 2018) of the Interstate Fishery Management Plan, the yellow eel coastwide catch cap was increased to 916,473 lbs to reflect a correction in the historical harvest. Management action will now be initiated if the yellow eel coastwide cap is exceeded by 10% (1,008,120 lbs) in two consecutive years. If the management trigger is exceeded, only those states accounting for more than 1% of the total yellow eel landings will be responsible for adjusting their measures. A workgroup, formed from Management Board members, developed an overage policy that defined the process to equitably reduce landings back to the cap, if and when it occurs. This policy obtained final approval from the Management Board October 2019 and is included as an appendix in Addendum V.[1]

Maryland conducts both fishery dependent and independent annual surveys. Landings from the commercial eel pot fishery are monitored and subsampled for biological data. Fishery independent monitoring includes a yellow eel pot survey in the Sassafras River and a YOY survey in the Coastal Bays. Yellow eels are subsampled for sex and age determination and the prevalence of the swim bladder parasite, *Anquillicolla crassus.* Average prevalence rate of parasites among Chesapeake Bay eels was 52% from 2004-2021.[9] The effect of the parasite on yellow and silver eel life history stages is unknown.

The Maryland Department of Natural Resource Fish Passage Program added eels to its list of targeted species many years ago. Blockage removal projects take into consideration whether eels would benefit from implementing a proposed project. The ASMFC published the Proceedings of a Workshop on American Eel Passage Technologies (July 2013). The workshop participants agreed that traditional fish passage structures (fishways and fish lifts) are ineffective at passing juvenile eels and specialized eel passage structures are necessary. Since the removal of Bloede Dam on the Patapsco River (September 2018), use of the upstream ladder at Daniels Dam

has increased from an average of 28 eels per year (2014-2018) to 1,361 eels per year.[11]

The Fishery

Ninety-nine percent of commercially harvested American eels were caught using eel pots. Total reported commercial eel harvest for Maryland in 2021 was 303,902 pounds. A total of 241,766 lbs were reported on finfish reporting forms and 62,136 lbs were reported for personal use on the crab reporting forms. After nine consecutive years of above average harvest from 2010-2018, harvests have been below average in years 2019-2021 (Figure 1). The fishery, which experienced lower demand and poor market conditions in 2019, was significantly impacted by the Covid-19 pandemic and the effects on the export market. The substantial drop in recent harvest over the last two years is believed to be market driven.[12]

Since 2010, Maryland has comprised 61% of the total coastwide harvest, including 64% in 2020 and 77% in 2021.[13]

Recreational harvest data for American eel is not available from the Marine Recreational Information Program (MRIP) because of lack of data.[14] Consequently, the recreational harvest of eel is negligible.

Issues/Concerns

In 2010, the USFWS received a petition to list the eel as a threatened species under the ESA and was followed by a lawsuit in 2012. After an in depth review, the USFWS concluded that the American eel resource was stable and did not warrant protection under the ESA (2015).

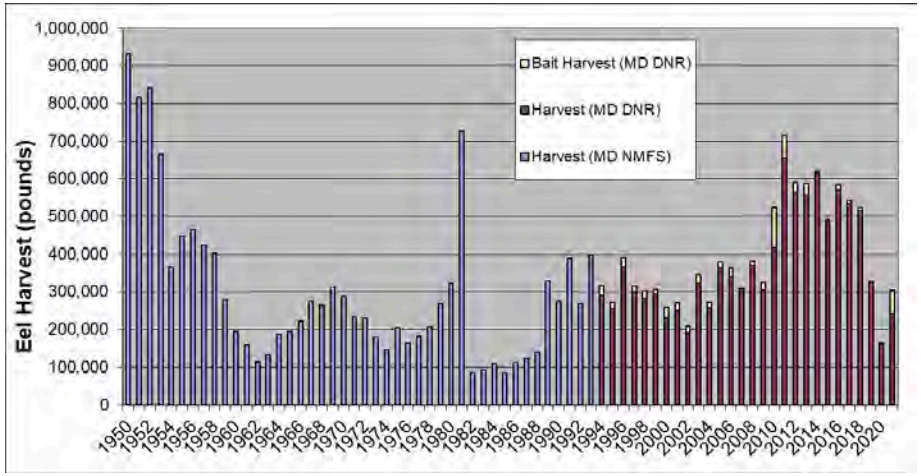
In 2010, the European Union limited trade of European eels to within the European Union only. This greatly increased the demand for glass eels to support the Asian aquaculture market. The only legal glass eel fisheries along the Atlantic coast are in the states of Maine and South Carolina.[3] In 2012, the estimated value of the coastal glass eel fishery was $40 million when the price per pound exceeded $2,000. Despite prices dropping to $400 - $650 per pound in 2014, prices commonly reached $2,000 per pound from 2015-2020 with prices reaching an all-time high of $3,000 per pound in 2019. High economic value for glass eels make them a prime target for poaching and illegal activities.[3] In 2019 and 2020, ASMFC granted North Carolina and Maine aquaculture harvester permits that would allow the harvest of 200 lbs of glass eels. In 2021, only Maine applied and was granted the harvester permit. Under Addendum IV, other states may submit proposals to harvest glass eels for aquaculture purposes.

A multi-jurisdiction and multi-year undercover operation into the illegal trafficking of American glass eels by the USFWS resulted in twenty guilty pleas through 2018. The guilty pleas accounted for more than $7.0 million worth of illegal glass eel sales in various East Coast states.[15]

Stream and river blockages continue to reduce American eel access to significant amounts of historic habitat. Downstream movement of yellow and silver eels is particularly problematic at hydropower structures where mortality can be as high as 100%. The USFWS monitors eel abundance at the Conowingo Dam, the first major obstruction to eel passage on the Susquehanna River. From 2008-2016, a seasonal elver ladder was operated at the dam to capture and transport eels upstream. Over 800,000 eels were released at more than 40 stocking sites throughout the Susquehanna River watershed.[16] Starting in 2017, and in accordance with the Federal Energy Regulatory Commission (FERC), a license was issued for the Muddy Run Pump Station, where Exelon is responsible for the collection and transport of American eels from the base of the Conowingo Dam and from the Octoraro Creek. From 2017-2020, a combined total of 578,313 eels from the Conowingo Dam and the Octoraro Creek eel facility were transported and released at ten designated locations in the Susquehanna River watershed.[17] In 2021, a total of 664,345 eels from the Conowingo Dam and Octoraro Creek eel facility were transported to designated locations upstream in the Susquehanna River watershed.[18]

Invasive species can cause ecological and/or economic harm to an environment. Maryland's invasive fishes, particularly blue catfish and northern snakehead, have expanded their range into all major river systems of Maryland's tidal Chesapeake Bay. Northern snakeheads have also established populations in several non-tidal habitats. They pose a significant threat to the ecosystem because of their rapidly increasing populations and capacity to consume significant amounts of native species. Although gut analysis has indicated eel is not a primary food source for blue catfish and northern snakehead, they have been found in stomach contents of each.[19] Increased predation on eels among invasive fish would lead to increases in natural mortality.

Figure 1. American eel commercial landings in Maryland, 1950-2021. Data for the years 1950-1993 obtained from the National Marine Fisheries Service.[2] Data for years 1994-2021 was provided by the Maryland Department of Natural Resources.[13]



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[19] Personal communication from Joseph Love, Maryland Department of Natural Resources, Fishing and Boating Services.

1991 Chesapeake Bay American Eel Management Plan Implementation Table			
Strategy	**Action**	**Date**	**Comments**
1.1 The jurisdictions will adopt a conservative management approach until stock assessment analyses have been completed for American eels in the Bay.	1.1A) Maryland and the Potomac River Fisheries Commission will adopt a minimum size limit of 6 inches for American eels in the Bay. B) Virginia will continue its prohibition on the taking of elvers and will adjust its definition to correspond to a 6” minimum size limit.	1992 1993	Glass eel and elver fisheries are prohibited in the Chesapeake Bay and there is no commercial harvest limit. The commercial season is open all year for pots and traps. VA restricts other gear from January 1 to August 31. MD, PRFC, VA recreational limit is 25 eels/person/day. Limit for charter/head boat captain or crew is 50 eels/day. There are no harvest regulations in the District of Columbia and PA.
		2005/2006	A coastal stock assessment was conducted in 2005, but the peer review panel determined that the terms of reference were partially or insufficiently met.
		2012	A benchmark coastal stock assessment was completed in 2012 and concluded that eels were depleted along the coast.
		2013	Addendum III to the Interstate Eel FMP required an increase in minimum size from 6” to 9” for all fisheries. Starting in 2014, harvest of eels is prohibited from 9/1-12/31 by any gear other than a baited eel pot or spear. i.e. no harvest of eels with fyke or pound nets.
		2014	Addendum IV was released for public comment during summer 2014 and adopted in October 2014. The addendum establishes a coastwide commercial catch cap for the yellow eel fishery, the implementation of state-by-state commercial quotas if management triggers are met and a quota for the glass eel fishery.
		2015/2016	Maryland initiated an amendment to the CBAE FMP to adopt current & future ASMFC management requirements, update the status of the eel resource, and provide a framework for managing and monitoring the fishery. Amendment 1 was adopted by reference into MD regulations in the fall 2016. Based on ASMFC Addendum IV, a state-by-state quota system would need to be implemented if one of the management triggers were met: (1) exceeding coastwide quota by more than 10% in a given year, or (2) exceeding the coastwide quota for two consecutive years regardless of the percent overage. With the adoption of Addendum V (August 2018), the management measures in Addendum IV are no longer valid.
		2017	See Amendment 1 -Action 4

	1.2A) Maryland will implement a ½ x ½" minimum mesh size for eel pots. B) Virginia and the Potomac River Fisheries Commission will continue to enforce a ½ x ½" minimum mesh size for eel pots. Virginia will continue to enforce the escape panel requirements in ½ x ½" mesh pots.	1993 Continue 2017	MD, VA and PRFC currently enforce the ½" x ½" minimum mesh size for eel pots**.** Eel pots in MD with undersize mesh require a 16 in^2 escape panel of ½" x ½" mesh. In MD, pots with mesh size <½" require escape panels. Virginia requires a ½" x 1" escape panel in ½" x ½" mesh pots. Addendum III (2013) to the Interstate Eel FMP requires that by January 1, 2017 the entire pot must be ½" x ½" mesh. Escape panels are no longer allowed in small mesh pots (< ½" mesh).
	1.3 Upon restoration of American eels to the Susquehanna River basin, the Pennsylvania Fish Commission (PFC) will adopt regulations to prevent the overharvest of small eels.	Continue 2010 2013	CBP fish passage goal of 2,807 miles opened by 2014. The 2010 SRAFRC restoration plan did not have specific restoration goals for eel. Addendum III (2013) to the plan specifies eel restoration goals http://www.srbc.net/pubinfo/docs/SRAFRC_American_Eel_Restoration_Plan_20140527_220124v1.pdf There are no harvest regulations in PA.
2.1 Catch and effort statistics for the American eel crab bait fishery will be obtained.	2.1 Maryland will require the reporting of American eels used for the crab bait fishery on their finfish reporting forms.	1993 2007 Continue 2017 2019	Watermen with crab licenses report the number of eels caught for bait on their crab reporting forms. Information gathered from the Crab Reporting Forms indicate that previous bait estimates were probably too high. ASMFC requires coastal states/jurisdictions to collect eel catch and effort data from all eel fisheries. MD commercial crabbers are required to report their harvest and effort of eels used for bait. These forms were changed in 2010 and may have increased reporting. Commercial crabbers can use up to 50 eel pots with no catch limit. All commercial license holders must also obtain an American eel harvester permit and are required to report in the manner specified by the Department. This includes commercial crabbers who intend to harvest eel for trotline bait. Maryland removed the requirement to obtain an eel harvester permit. Approximately 20 eelers comprise 90% of the annual harvest. For this reason and at the advice of the American Eel Workgroup, Maryland decided the eel permit was not necessary.
3.1 The jurisdictions will increase their understanding of the American eel resource in the	3.1A) Maryland and Virginia will continue to collect catch and effort data from the live-eel fishery and begin monitoring the bait eel fishery.	1997 2000	MD conducts an annual population study. ASMFC implemented mandatory commercial reporting by life stage.

Chesapeake Bay. Important research topics include but are not limited to the following: fishery independent estimates of abundance; mortality rates; the effects of fishing exploitation on growth; the factors that influence recruitment in the Bay; and how economic aspects affect the eel fishery.	B) PRFC will continue to collect catch and effort data from their commercial fishery.	2006 Continue 2017	ASMFC adopted Addendum I to the Coastal Eel FMP to improve data collection and subsequent stock assessments. See Amendment 1-Action 1
	3.2 Maryland, the Potomac River Fisheries Commission, and Virginia will encourage research to collect basic biological and socioeconomic information.	Continue 2000 2006 2007 2010 2015	The ASMFC coastal eel FMP required states/jurisdictions to conduct an annual young of year survey. MD initiated an annual fishery independent eel pot survey and silver eel survey. Eels are also sampled for disease (swim bladder parasite Anquillicolla crassus) prevalence. CB long-term average (2004-2017) was 51%. USFWS determined there was no need to list eels as endangered or threatened. USFWS was petitioned a second time in 2010 for an eel status review. The published status review of the second petition was published in October 2015 and determined that the eel population is stable and does not warrant protection under the ESA. USFWS completed an American eel biological species report that reviews the best available information on eels in support of the status review.
4.1 The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to promote the commitments of the 1987 Chesapeake Bay Agreement. The achievement of the Bay commitments will lead to improved water quality and enhanced biological production. In addition, the jurisdictions have committed to providing upstream passage for migratory fishes.	4.1 The jurisdictions will continue to provide for fish passage at dams, and to remove stream blockages wherever necessary.	2005 2014 2008 2010 2012	The CBP fish passage goal was updated to include opening an additional 1,000 miles of tributary from 2005 to 2014 or 2,807 miles by 2014. The 2014 CB Watershed Agreement (prompted by Executive Order 13508) included an outcome for opening 1,000 miles of migratory fish passage by 2025 (baseline mileage 2,041). American eel was identified as one of the focal species. ASMFC approved Addendum II to the Coastal eel FMP which placed an emphasis on improving upstream and downstream passage. USFWS conducted a study to determine the timing & cues for out-migrating eels in the Shenandoah River. Results of the study indicate that outmigration is variable and sometimes protracted.* Study of the Embry Dam removal on the Rappahannock River indicated that the restoration resulted in increased numbers of eels as far as 100 miles upstream.**

		2015 2017 2019 2018	Through 2015, MD DNR's Fish Passage Program has completed 79 projects and reopened 457 miles of upstream habitat in Maryland. Designs and permits have been obtained for the construction of eel ladders at Dams 4 and 5 on the Potomac River. USFWS and NPS are working to find funding for the eel passage and ecological restoration effort. MD DNR supports the restoration efforts. Construction of fish passage at Dam 5 completed October 2019. The Department of Energy (DOE) Water Power Technologies Office and the USACE, Pacific Northwest National Laboratory (PNNL), USFWS, and Cube Hydro have procured funding for an acoustic eel tagging study at Dams 4 and 5 on the Potomac River. The study was conducted during April/May 2018.
	4.2 The jurisdictions will continue to set specific objectives for water quality goals and review management programs established under the 1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement call for: A) Developing habitat requirements and water quality goals for various finfish species. B) Developing and adopting basinwide nutrient reduction strategies. C) Developing and adopting basinwide plans for the reduction and control of toxic substances. D) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and nonpoint sources. E) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system. F) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation. G) Managing population growth to minimize adverse impacts to the Bay environment.	Continue 2014 2014 2014 2015 2017	The Chesapeake Bay Program develops, revises, and monitors goals and strategies for restoration. The 2014 CBP Watershed Agreement revised the goals and outcomes for natural resources, water quality and stewardship. For more information: http://www.chesapeakebay.net/chesapeakebaywatershedagreement/page Results of the 2012-2014 assessment period indicate that 34% of the water quality standards for dissolved oxygen, water clarity/underwater grasses and chlorophyll a for the Chesapeake Bay were met during this time. In 2014, 59% of the Chesapeake Bay met the bottom habitat goal, scoring at least three on the one-to-five Benthic index of Biotic Integrity scale. In 2015, there were an estimated 91,621 acres of underwater grasses in the Chesapeake Bay, achieving 49% of the 185,000-acre goal. In 2017, an estimated 104,843 acres of underwater grasses were mapped in the Chesapeake Bay. This is about 57% of the 185,000-acre goal to which the Chesapeake Bay Program has committed to and is 14,843 acres greater than the partnership's 2017 restoration target. https://www.chesapeakebay.net/state/underwater_grasses

		2018	In 2018, an estimated 91,559 acres of underwater grasses were mapped in the Chesapeake Bay, approximately 50% of the Chesapeake Bay Programs goal.
		2018	MD DNR, in conjunction with Chesapeake Conservation Corps, have been rearing and studying two native freshwater mussel species in the Joseph Manning Hatchery, and plan to reintroduce these valuable mussels to historic habitats throughout Maryland.

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Amendment 1 to the 1991 Chesapeake Bay American Eel Fishery Management Plan (2016) Implementation Table			
Strategy	**Action**	**Date**	**Comments**
Stock Status: Since the American eel resource consists of a single, migratory stock along the Atlantic coast, Maryland will support and cooperate with the Atlantic States Marine Fisheries Commission's (ASMFC) data collection and stock assessment processes.	1. Follow the ASMFC guidance and compliance requirements for American eel.	2016	Maryland participated in an ASMFC sponsored otolith exchange (aging) for American eel. Staff read approximately 250 samples provided by participating aging labs from Maine to Florida. The goal is to develop a standardized protocol for processing and reading samples, compare ageing accuracy in and between ageing labs, and identify any persisting issues along the coast.
		2017	MD has conducted an American eel population study since 1997 that includes collecting catch and effort data from the commercial eel fishery, completing an annual young-of-year survey, and submitting an annual compliance report to ASMFC.
	2. Continue to collect biological data to support coastal stock assessments and contribute to the development of biological reference points.	2017	The Maryland American eel Project conducts ongoing surveys that provide relative abundance estimates and biological data, including length, weight, age, and sex that are critical to coastal stock assessments.
		2018	The Maryland American eel Project collected fishery-dependant data from the Choptank and Patuxent rivers and fishery-dependent data from the Sassafras River.
		2019	The Maryland American eel Project collected fishery-dependant data from Eastern Bay and Manokin River and fishery dependent data from the Sassafras River.
	3. Improve stock status by reducing overall mortality and enhancing population levels by increasing the availability of habitat, especially through the removal of blockages to upstream and downstream migration.	2017	Designs and permits have been obtained for the construction of eel ladders at Dams 4 and 5 on the Potomac. USFWS and NPS are working to find funding for the eel passage and ecological restoration effort. MD DNR is in support of the restoration effort and has agreed to be an ally in search of obtaining funding for the project.
		2017-2019	The Bloede Dam (Patapsco River) dam removal project began in fall 2017. Work to remove the actual dam structure is scheduled for fall 2018 and completion is tentatively set for early summer 2019.
		2019	The Bloede Dam removal project was successfully completed in August 2019 opening 65 miles of historic habitat for the first time in nearly 100 years.

		2020	As a result of the completion of Bloede Dam removal on the Patapsco River (September 2018), use of the upstream ladder at Daniels dam has increased from an average of 28 eels/year (2014-2018) to 342 eels/year.
		2020	In October 2019, an agreement was reached between the Maryland Department of the Environment (MDE) and Exelon as part of the FERC relicensing of the Conowingo Dam that will consist of more than $200 million to support environmental initiatives. This includes $11 million for upgrades and operational changes to improve the passage of migrating fish and eels and an additional $1 million for eel-related research and projects. An eelway at dam 5 on the Potomac River was completed October 2019. Discussions have begun on providing upstream and downstream passage at the Washington Aqueduct (WAD), a semi-blockage downstream of Dams 4 and 5 on the Potomac.
		2021	A total of 3,419 eels were counted at the eel ladder at Daniels Dam in 2021, a significant increase from 342 eels/year in 2019-2020.[10]
		2021	A total of 664,345 eels from the Conowingo Dam and Octoraro Creek eel facility were transported to designated locations upstream in the Susquehanna River watershed in 2021.
	4. As the status of the American eel stock changes over time, adjust management strategies to meet conservation and protection objectives.	2017	A coastwide stock assessment update was completed in fall 2017 and concluded that the American eel population was similar to the population assessment in 2012. The overall stock remains depleted. Stability was noted in the Mid-Atlantic eel population, as well as, the coastwide landings.
		2017/2018	ASMFC Draft Addendum V was approved in fall 2017 and the Management Board approved it in August 2018. The Addendum slightly increased the coastwide commercial cap, redefined the management trigger, and removed the state quotas. Addendum V will be implemented starting January 1, 2019.
		2020	ASMFC initiated a new benchmark stock assessment in August 2020 with a tentative completion date of fall 2022.
Fishery Management: Maryland will reduce overall mortality on the American eel resource as required by the Atlantic States Marine Fisheries	5. Maryland will establish an eel harvester permit for all commercial eel harvesters including crab license holders, in order to obtain timely, accurate and verifiable harvest reporting for American eels caught from Maryland waters. If a state quota is	2017	An eel harvester permit is required for all commercial eel harvesters, including crab license holders intending to harvest eels for bait. A total of 540 permits were issued from August 2017 to August 2018. If an ASMFC quota is implemented, the Department can modify, open or close the season or adjust catch limits by public notice.

Commission (ASMFC). When the American eel stock is rebuilt, management strategies may become less restrictive.	implemented, the Department will require daily reporting with the procedures and protocols to be determined.	2019	Maryland removed the requirement to obtain an eel harvester permit.
	6. Maryland will continue to implement minimum size limits, possession limits, mesh size requirements, seasonal restrictions, gear restrictions and other management measures as necessary to meet the management framework for protecting and conserving the American eel resource.	2017 2017	Addendum III to the ASMFC Interstate Eel FMP (2013) required ½" x ½" mesh for the entire eel pot starting January 1, 2017. Escape panels will no longer be allowed in small mesh pots (< ½" mesh). Maryland implemented temporary regulations in fall 2017. From September 1 to November 30, no commercial eel harvest was allowed on Saturday or Sunday. These regulations were intended to keep the 2017 coastwide harvest below the Addendum IV management trigger.
	7. Maryland will implement and manage the commercial eel fishery by a quota system when one of the ASMFC management triggers is met.	TBD 2018 2019 2019 2020 2021 2022	Dependent on annual coastal harvest. Although the 2017 coastwide yellow eel harvest exceeded 907,671 lbs, the coastwide cap implemented by ASMFC Addendum IV, state-specific quotas will not be initiated. The ASMFC Management Board approved Addendum V which supersedes IV. The coastwide commercial cap was slightly increased, the management trigger was redefined and the state quotas were removed. Addendum V will be implemented beginning January 1, 2019. ASMFC Management Board workgroup approved an overage policy in October 2019 that defines the process to equitably reduce landings back to the cap, if and when it occurs. This is included as an appendix in Addendum V. 2018 preliminary U.S. landings were 781,220 lbs, 15% below the Coastwide cap of 916,473 lbs established in Addendum V. 2019 preliminary U.S. landings were 507,566 lbs, 45% below the Coastwide cap. 2020 preliminary U.S. landings were 255,642 lbs, 72% below the Coastwide cap. 2021 preliminary U.S. landings were 394,727 lbs, 57% below the coastwide cap.

	8. Maryland will continue to prohibit an elver fishery.	Continue 2013	Maryland and Virginia implemented a minimum size limit of 6” for American eels in 1991. The minimum size limit prohibits an elver fishery. Addendum III to the Interstate Eel FMP increased minimum size from 6” to 9” for all fisheries.
	9. Maryland will work with the stakeholders to evaluate and discuss challenges and priorities in managing the American eel fishery.	2016 2017	In 2016, an Eel Workgroup, comprised of industry participants was formed with a goal of developing a framework for managing a yellow eel quota, if required. The Eel Workgroup agreed it was in their best interest to take management measures to reduce eel harvest in the fall of 2017 with a goal to reduce coastwide harvest and remain below the Addendum IV management trigger thus avoiding the requirement for state-by-state harvest quotas. With the adoption of Addendum V (August 2018), state harvest quotas have been removed.
Monitoring: Maryland will continue to conduct fishery dependent and fishery independent monitoring in the Chesapeake and Atlantic Coastal Bays to collect biological data essential for stock assessments and managing the American eel resource.	10. Maryland will continue to conduct an annual YOY survey, the fishery independent adult surveys and the commercial harvest survey.	Continue 2016 2020 2021	ASMFC implemented mandatory commercial reporting by life stage. ASMFC adopted Addendum I (2006) to the Coastal Eel FMP to improve data collection and subsequent stock assessments. Maryland’s American eel Project has conducted an annual YOY survey since 2000, a fishery independent eel pot survey in the Sassafras River since 2006, a fishery dependent biological survey since 1997, and a silver eel study at a Corsica River tributary since 2006. The program also compiles and analyzes catch and effort data annually from the commercial eel pot fishery. Maryland participated in an ASMFC sponsored otolith exchange (ageing) for American eel. Staff read approximately 250 samples provided by participating ageing labs from Maine to Florida. The goal is to develop a standardized protocol for processing and reading samples, to compare ageing accuracy in and between labs, and to identify any persisting issues along the coast. The Maryland Eel Project collected fishery dependent data from Eastern Bay and the Potomac River and fishery independent data from the Sassafras River. In addition, the annual YOY survey was completed in Maryland’s coastal bays. The Maryland Eel Project collected fishery dependent data from Manokin and Potomac rivers and fishery independent data from the Sassafras River.

Acronyms

ASMFC – Atlantic States Marine Fisheries Commission
CB – Chesapeake Bay
CBAE – Chesapeake Bay American Eel
CBP – Chesapeake Bay Program
ESA – Endangered Species Act
FMP – Fishery Management Plan
MD – Maryland
MD DNR – Maryland Department of Natural Resources
NPS – National Park Service
PA – Pennsylvania
PFC – Pennsylvania Fish Commission
PRFC – Potomac River Fisheries Commission
SRAFRC – Susquehanna River Anadromous Fish Restoration Cooperative
USFWS – United States Fish & Wildlife Service
VA – Virginia
YOY – Young of Year

2021 Maryland FMP Report (December 2022)
Section 2. Alosines: a) Shad and b) Herring
2a) American shad (*Alosa sapidissima*) and hickory shad (*Alosa mediocris)*

The most recent benchmark stock assessment for American shad was accepted by the board of the Atlantic States Marine Fisheries Commission (ASMFC) in 2020. Twenty-three stocks were assessed coastwide, including four in Maryland. Unfortunately, the condition of most stocks have not improved since the 2007 assessment despite significant efforts to restore coastwide anadromous fish populations. Barriers to spawning habitat, water quality, bycatch in ocean fisheries, and introductions of invasive predators continue to be major impediments to alosine fish restoration. While the ASMFC requires states to monitor hickory shad populations, there have been no coastwide assessments for the species due to a scarcity of data.

Fishery Management Plans (FMPs)

The ASMFC adopted the Interstate Fishery Management Plan for Shad and River Herring in 1985. In response, Chesapeake Bay jurisdictions implemented the Chesapeake Bay Alosid [*sic*] Management Plan (CB Alosine FMP) in 1989 to coordinate shad and river herring management among Chesapeake Bay jurisdictions. The CB Alosine FMP identified declining abundance, overfishing, insufficient research and monitoring, and habitat loss as problems. The plan set guidelines to continue the American shad moratorium in Maryland and reduce exploitation rates in Virginia; remove stream blockages and reopen historic habitat; and continue stocking hatchery-raised fish. The CB Alosine FMP Amendment 1 (1998) continued the shad moratorium in Maryland, initiated review of criteria to reopen a shad fishery, and initiated development of measurable restoration targets.

The ASMFC implemented Amendment 1 to the Interstate Fishery Management Plan for Shad & River Herring in 1999. The amendment mandated a 40% reduction in the American shad ocean intercept fishery by 2003 and a closure by 2005. In-river commercial fisheries were also limited; not to exceed a fishing mortality rate of 30% of the maximum spawning potential of an unfished population (F_{30}). Technical Addendum I (2000) adjusted state fishery independent and dependent monitoring programs but did not affect Maryland's obligations. Addendum I (2002) clarified hatchery-rearing requirements for Alosa species. Amendment 3 (2010) was enacted by ASMFC in response to the continued lack of improvement in American shad abundance. Amendment 3 established an instantaneous total mortality (fishing plus natural mortality) benchmark of Z_{30}, refined the juvenile recruitment failure definition to be more conservative, mandated states to monitor bycatch and discards, and required states with commercial and/or recreational (excluding catch and release) American shad fisheries to have approved fishing and habitat sustainability plans.

The Potomac River Fisheries Commission (PRFC) submitted a sustainable fishery management plan for American shad in 2012. This plan underwent a five-year review and was re-approved by ASMFC in 2017. Habitat restoration plans were approved by ASMFC for Maryland, District of Columbia, and Virginia in 2014. All three plans were updated and approved in 2021. All updated plans can be found on the ASMFC website (https://asmfc.org/species/). The ASMFC board approved a new benchmark stock assessment for American shad in August 2020. The assessment established a more conservative instantaneous total mortality benchmark of $Z_{40\% \text{ SBPR}}$ and included a coastwide assessment of American shad habitat. This metric represents the total mortality rate that reduces the spawning stock biomass per recruit (SBPR) to 40% of what that level would be in the absence of anthropogenic mortality.

The adequacy of the CB Alosine FMP, including Amendment 1, was evaluated in 2012 to determine if the strategies and actions provided an appropriate management framework for addressing management changes implemented by ASMFC. The plan review team (PRT) determined that the CB Alosine FMP's strategies and actions were adequate to meet ASMFC compliance requirements and Chesapeake Bay management goals. Following input from the Maryland Sport Fisheries Advisory Commission and the Tidal Fisheries Advisory Commission, the PRT recommended no changes to the CB Alosine FMP. However, when the stock has adequately recovered and a limited fishery is ready to be opened, an amendment will need to be developed.

In 2006, the National Oceanic and Atmospheric Administration's (NOAA) Chesapeake Bay Fisheries Ecosystem Advisory Panel adopted a Fisheries Ecosystem Plan for Chesapeake Bay. In 2009, Maryland Sea Grant facilitated development of Ecosystem-based Fisheries Management for the Chesapeake Bay Alosine Background and Issue Briefs (American shad, hickory shad, alewife, and blueback herring; in cooperation with state, federal, and academic representatives. The issues section examined four stressor categories: habitat (migratory barriers, flow and water quality, land-use ecology, and physical alteration), food web (forage, competition, predation, freshwater ecology, and vectors of biological material), stock dynamics (stock assessment history, anthropogenic mortality, life history, connectivity, and stock structure), and socioeconomic (cultural, economic, and environmental considerations, restoration, and management guidelines).

Stock Status

American shad harvest in Maryland declined in the late 1950s and reached historic low levels in the mid-1970s, where it has remained since (Figure 1)[1]. The Maryland Department of Natural Resources (MD DNR) has conducted a population assessment on the Susquehanna River in the Conowingo dam tailrace since the mid-1980s. These estimates indicate that American shad abundance generally increased from

1986 to 2000, followed by a rapid decline from 2001 through 2007.[1,2] American shad abundance has been relatively stable at low levels in recent years, though some decline may still be occurring.[1] In 2021, to prevent the upstream passage of invasive species (specifically northern snakehead, blue catfish *Ictalurus furcatus*, and flathead catfish *Pylodictis olivaris*), fish collected in the fish lifts were not emptied directly into Conowingo pond above the dam. Instead, all fish collected in the fish lifts were manually sorted by species, invasive species were removed from the tailrace, and American shad and river herring were truck and transported upstream to suitable spawning habitat.[3] In 2021, 6,825 American shad were lifted, of which, 6,413 were successfully truck and transported upstream.[3] The 2021, the American shad population estimate for the Susquehanna River below Conowingo Dam was 75,308 fish, which was the lowest estimate since 1993 (Figure 2).[1] In 2022, the majority of lifted American shad and river herring were again truck and transported upstream.

American shad abundance in the Potomac River is measured using an index based on the number of pounds (lbs) per pound net day. The Potomac River restoration target is 31.1 lbs; the mean commercial pound net landings during the 1950s. Abundance has steadily increased since 2000 and has exceeded the restoration target since 2011 (Figure 2; I. Braun, PRFC, pers. comm.).

There are several restoration efforts throughout the Chesapeake Bay region that stock American shad and regularly evaluate hatchery contribution. Sixty-four percent (n = 189) of adult American shad sampled from the Conowingo Dam tailrace in 2021 were of wild origin. In the Choptank River, adult American shad are infrequently encountered by monitoring surveys, but the number of juveniles collected in 2021 was the second highest total in the history of the survey (n = 659); 26% of juveniles examined in 2021 were wild origin fish.[4] The proportion of wild adult American shad in the Rappahannock River (n = 27) in 2021 was 100%.[5]

Hickory shad populations in the Patuxent and Choptank rivers were determined to be self-sustaining in 2014 after 11 and 18 years, respectively, of stocking efforts. The proportion of wild, spawning adult hickory shad in the Patuxent River had been ≥ 80% in 8 of the last 10 years and was 91% in 2014.[6] The proportion of wild, spawning adult hickory shad in the Choptank River from 2001 - 2013 varied between 29% - 85%. In 2014, 74% of spawning adults were wild.[6] Monitoring on these rivers occurs every three years to continue trend data. A stable population of spawning adult hickory shad has been present in the lower Susquehanna River since 1996 without any stocking.[6] Nineteen percent of female and 29% of male hickory shad collected near the historic town of Lapidum were repeat spawners in 2021.[6]

The Patapsco River has recently become the focus of stocking efforts for both American and hickory shad. Dam removals have increased available habitat to migratory fish. Most notably, Bloede dam was breached in 2018 and complete removal and streambed restoration was completed in 2019. Access to 60 miles of aquatic habitat was restored with the removal of this dam. Wild fish accounted for 14% of all juvenile American shad (n = 28) collected from the Patapsco River in 2021.[4] No hickory shad juveniles were recaptured in 2021.[6]

Current Management Measures

Harvest of American shad from the Chesapeake Bay has been prohibited by Maryland since 1980, by PRFC since 1982, and by Virginia since 1994. Maryland allows commercial fishermen a 2 fish per day bycatch of dead American shad for personal use. No sale of American shad bycatch is allowed in Maryland. Virginia maintains an American shad bycatch permit for the gillnet fishery. Bycatch permit holders are allowed up to 10 fish per vessel from permitted areas as long as a greater number of spot, croaker, bluefish, catfish, striped bass, or white perch are landed. PRFC allows a 2% bycatch of American shad by volume of the total catch with a 2 bushel per day limit per licensed fishermen. Pennsylvania and New York also prohibit harvest of American shad in the Susquehanna River basin. All Atlantic coast states closed their American shad ocean intercept fisheries in 2005.

Maryland enacted a hickory shad moratorium in 1981. The District of Columbia and PRFC prohibited hickory shad harvest in 1992 and 1995, respectively. In Virginia, there are no regulations for hickory shad caught in their portion of the Chesapeake Bay or its tributaries.

The National Marine Fisheries Service (NMFS) enacted the New England Fishery Management Council's (NEFMC) Amendment 5 to the Atlantic Herring FMP in 2014.[7] Amendment 5's objectives to improve monitoring and minimize bycatch of river herring catch are anticipated to also reduce at-sea mortality of shad.[7] The 2021-2023 shad and river herring catch cap for the Atlantic herring fishery was set at 361 metric tons (mt) coastwide.[8] This quota was divided among four fishery regions/gears including the Gulf of Maine mid-water trawl (76.7 mt), Cape Cod mid-water trawl (32.4 mt), southern New England mid-water trawl (129.6 mt), and the southern New England bottom trawl (122.3 mt).[8] None of the aforementioned fisheries exceeded their shad and river herring catch cap in 2021.[9]

The Mid-Atlantic Fishery Management Council (MAFMC) adopted Amendment 14 (2014) to the Atlantic Mackerel, Squid, and Butterfish FMP to improve monitoring of these fisheries and to limit shad mortality in the Atlantic mackerel fishery. The MAFMC approved an initial annual incidental shad and river herring catch cap of 89 mt for the Atlantic mackerel fishery for 2019.[10] In 2021 and 2022, the incidental shad and river herring catch cap for the Atlantic mackerel fishery was set at 129 mt.[11] The catch cap was not exceeded in 2021.[9]

The Fisheries

In Maryland, commercial bycatch mostly occurs during the spring pound and fyke net fisheries. These nets are found in tributaries and the upper Chesapeake Bay.[1] Bycatch is limited to two dead American shad per day for personal use, assuming they were captured by gear legally deployed for the capture of other species.

The Marine Recreational Information Program (formerly Marine Recreational Fisheries Statistics Survey, MRFSS) stopped collection of American shad and hickory shad recreational data in 2009. Recreational catch and release fisheries for American and hickory shad occur in the tailrace below Conowingo Dam. Catch and release fisheries – primarily hickory shad – also occur in Deer Creek and Octoraro Creek, tributaries to the lower Susquehanna River. The MD DNR conducts a voluntary angler logbook survey and an annual creel survey of shoreline anglers along the Conowingo Dam tailrace.[1] Since 2014, anglers have had the option to participate in the logbook survey online through the MD DNR's website (https://dnr.maryland.gov/Fisheries/Pages/survey/index.aspx). According to the logbook survey, the catch rate of American shad has varied without trend since 2001 (Figure 3).[1, 2] An active catch and release recreational fishery for both shad species also occurs in the Potomac, Patuxent, and Choptank rivers, but fishing effort is lower than on the Susquehanna river.[4] In 1998, catch and release mortality of 309 American shad at the Conowingo Dam tailrace was calculated to be 0.97%.[12] Mortality from the current recreational fishery is believed to be negligible.[1]

Issues/Concerns

Conowingo Dam remains a significant blockage to American shad migrating up the Susquehanna River in Maryland, despite substantial investment in fish lifts. Although American shad are captured in both the East and West fish lifts, hickory shad have rarely been documented in either lift.[1,3] The Maryland Department of the Environment reached a settlement agreement with Exelon Generation Corp LLC in Fall 2019. The agreement defines improvements to fish passage and water quality that must be achieved by Exelon over the course of the 50-year license. The agreement was approved by the Federal Energy Regulatory Commission in early 2021. It will take several years to implement the fish passage improvements required by the new license.

Comparisons between scale age and a fish's known age revealed a notable amount of bias and error.[13] Percent agreement among 13 biologists varied between 50% and 77%. Ageing accuracy was greatest for shad ages 3-6 (34%-49%), but decreased significantly for age 7 fish (12%) and age 8 fish (4%). Otolith sampling is not a feasible option because of the depressed stock status. The accuracy of using scales to determine repeat spawning remains problematic.[13] Currently, American shad mortality is assessed relative to total mortality benchmarks ($Z_{40\%SBPR}$) identified in the most recent stock assessment. The contribution of various sources of mortality such as ocean bycatch, dam turbines, pollution, and predation to total mortality remains unknown.[14] Additional data are required to estimate natural, anthropogenic, and fishery mortalities to develop appropriate biological benchmarks.

Currently, Maryland does not monitor commercial bycatch and discard of American shad as specified in ASMFC Amendment 3. Although the Maryland commercial finfish reporting forms have a designation for discards/bycatch, fishermen are not required to report bycatch or discards.

Figure 1. Time series of commercial landings of American shad, 1950-2021 in Maryland and Virginia.[15]

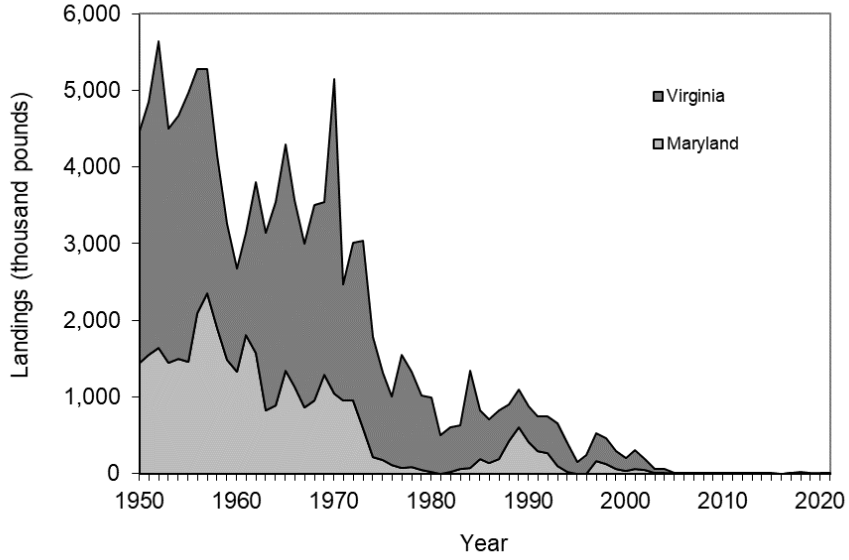


Figure 2. American shad population estimate for the Conowingo Dam tailrace (1986-20121), and the status of American shad restoration in the Potomac River (2000-2021; I. Braun, PRFC, pers. comm.).

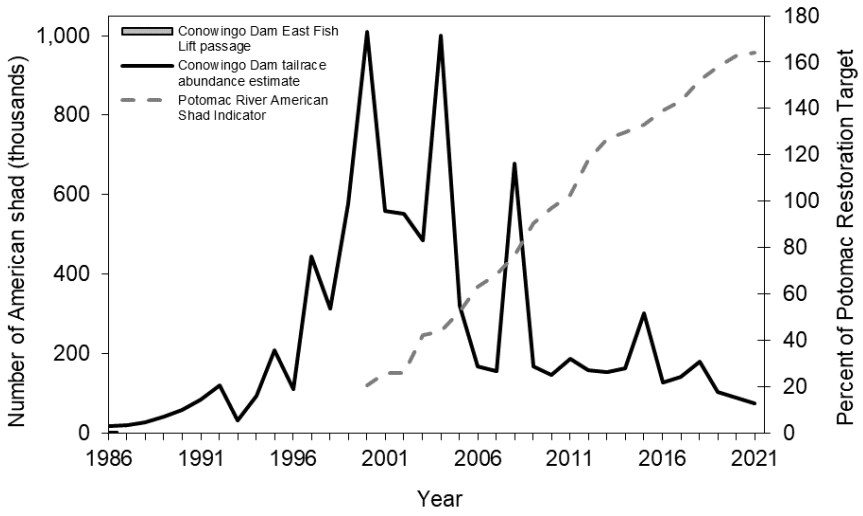
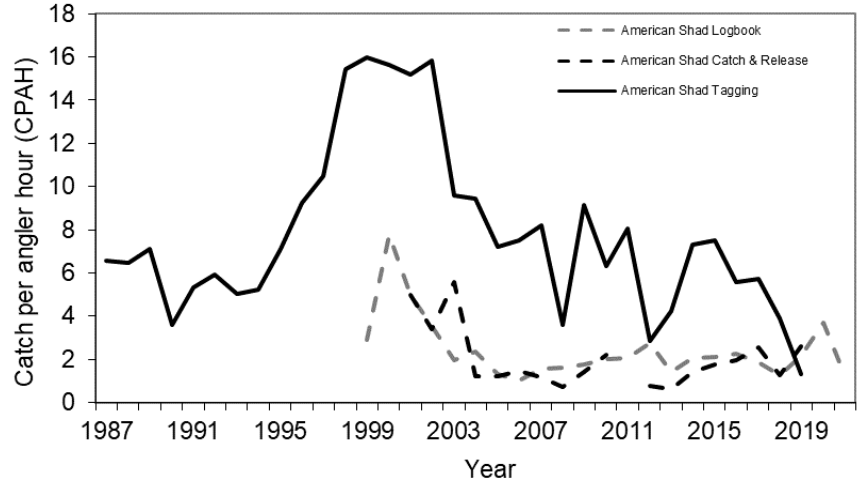


Figure 3. Average catch per angler hour from the MD DNR tagging study (1987-2021), the recreational angler logbook survey for American shad (1999-2021), and American shad catch and release fishery below Conowingo Dam (2001-2021, no data for 2011, 2020).[2]



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b) Alewife *(Alosa pseudoharengus)* and blueback herring *(Alosa aestivalis)*

The most recent benchmark stock assessment for river herring was completed in 2012. The assessment found that most river herring stocks were depleted relative to historic levels. The 2017 stock assessment update confirmed that coastwide river herring stocks remained depleted at near historic lows, though many systems saw an increase in abundance over the previous 10 years. Barriers to spawning habitat, water quality, bycatch in ocean fisheries, and introductions of invasive predators continue to be major impediments to alosine fish restoration. The next benchmark stock assessment for river herring was initiated in 2022 and is on track to be completed in 2023.

Fishery Management Plans

The ASMFC adopted the Interstate Fishery Management Plan for Shad and River Herring in 1985. In 1989, Chesapeake Bay States implemented the Chesapeake Bay Alosid [*sic*] Management Plan (CB Alosine FMP) to coordinate shad and river herring management. The CB Alosine FMP identified declining abundance, over-fishing, insufficient research and monitoring, and habitat loss as problems. The plan set guidelines to reduce river herring fishing mortality and remove impediments to access historic habitat.

The ASMFC enacted Amendment 2 (2009) to address coastwide declines in alewife and blueback herring stocks and to address the lack of fishery-dependent and independent monitoring for these species. Amendment 2 required states to have an ASMFC approved river herring sustainability plan by 2012 or close their river herring fisheries. Sustainability plans require development of a river herring juvenile index, a monitoring plan for spawning adults, and collection of commercial and recreational fisheries statistics including bycatch data. Maryland closed its river herring fisheries due to a decline and persistently low levels of river herring. As required by ASMFC, Maryland submits an annual compliance report.

In 2006, the NOAA Chesapeake Bay Fisheries Ecosystem Advisory Panel adopted a Fisheries Ecosystem Plan for the Chesapeake Bay. In 2009, Maryland Sea Grant facilitated development of an Ecosystem-based Fisheries Management Project for Chesapeake Bay alosine fishes (American shad, hickory shad, alewife, and blueback herring) in cooperation with state, federal, and academic representatives. The report examined four stressor categories: habitat (migratory barriers, flow and water quality, land-use ecology, and physical alteration), food web (forage, competition, predation, freshwater ecology, and vectors of biological material), stock dynamics (stock assessment history, anthropogenic mortality, life history, connectivity, and stock structure), and socioeconomic (cultural, economic, and environmental considerations, restoration, and management guidelines).

The National Marine Fisheries Service (NMFS) and the ASMFC published a coastwide conservation plan (2015) for river herring that utilizes input from experts (River Herring Technical Expert Working Group-TEWG) throughout the species range and is intended to be a dynamic web-based plan that can be easily updated. It can be accessed at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/habitat-conservation/atlantic-coast-river-herring-collaborative-forum

The plan has the following goals: identify key research needs for assessment and conservation, increase coordination of river herring research and conservation, identify funding sources for river herring research and conservation, identify conservation actions to address threats, cultivate research groups to address key topics, improve information to be used in the next assessment, improve information used in conservation efforts, further conservation efforts to address threats, and increase outreach about river herring.

Stock Status

The ASMFC's 2017 river herring stock assessment update determined that alewife and blueback herring populations remain depleted coastwide.[1] Furthermore, mean age and maximum length have decreased in some systems.

Spawning adult river herring in the Nanticoke River were sampled from commercial fyke and pound nets.[2] Relative abundance of adult alewife and blueback herring decreased over the timeseries of the survey (1989-2021).[2, 3] Forty-four percent of alewife and 41% of blueback herring were repeat spawners.[2,3] The MD DNR conducted the eighth year of a fishery independent river herring gill net survey in the North East River, developed to assess the spawning stock of alewife and blueback in the Upper Bay. Relative abundance of both alewife and blueback herring has varied without trend in the North East River since the inception of the survey (2013-2021).[3] In 2021, 776 alewife and 478 blueback herring were sampled; alewife catch was the highest in the history of the survey, but blueback catch decreased following a record high in 2019.[3] Thirty-four percent of alewife and 61% of blueback herring were repeat spawners. Seine surveys used to calculate juvenile abundance indices (JAI) show baywide declines in juvenile alewife since 2000, though blueback herring show no trend during this same time period.[3]

The Patapsco River has recently become the focus of restoration efforts for both alewife and blueback herring. Recent dam removals have increased available habitat to migratory fish. Most notably, the removal of Bloede dam was completed in 2019. Access to 60 miles of aquatic habitat was restored with the removal of this dam.

Current Management Measures

Maryland, Virginia, and the Potomac River Fisheries Commission (PRFC) instituted a recreational and commercial river herring moratorium, January 1, 2012. All river herring and river herring products imported into Maryland must include a bill of sale from a state with an approved river herring fishery [3] (Maine, New Hampshire, Massachusetts, New York, and South Carolina).

The National Marine Fisheries Service (NMFS) enacted the New England Fishery Management Council's (NEFMC) Amendment 5 to the Atlantic Herring FMP in 2014.[4] Amendment 5's objectives to improve monitoring and minimize bycatch of river herring catch are anticipated to also reduce at-sea mortality of shad.[4] The 2021-2023 shad and river herring catch cap for the Atlantic herring fishery was set at 361 metric tons (mt) coastwide.[5] This quota was divided among four fishery regions/gears including the Gulf of Maine mid-water trawl (76.7 mt), Cape Cod mid-water trawl (32.4 mt), southern New England mid-water trawl (129.6 mt), and the southern New England bottom trawl (122.3 mt).[5] None of the aforementioned fisheries exceeded their shad and river herring catch cap in 2021.[6]

The Mid-Atlantic Fishery Management Council (MAFMC) adopted Amendment 14 (2014) to the Atlantic Mackerel, Squid, and Butterfish FMP to improve monitoring of these fisheries and to limit shad mortality in the Atlantic mackerel fishery. The MAFMC approved an initial annual incidental shad and river herring catch cap of 89 mt for the Atlantic mackerel fishery for 2019.[7] In 2021 and 2022, the incidental shad and river herring catch cap for the Atlantic mackerel fishery was set at 129 mt.[8] The catch cap was not exceeded in 2021.[6]

The Fisheries

Alewife and blueback herring recreational fishery data have not been available from the Marine Recreational Information Program (MRIP) since 2009. All commercial and recreational river herring fisheries in Maryland are under a moratorium. When the fishery was open, commercial landings of river herring appeared to cycle from high to low approximately every 20 years (Figure 1). During that time, a decreasing trend in landings was evident. Commercial river herring landings were in decline around the mid-1900s and declined precipitously after 1968 (Figure 1). River herring landings failed to rebound after 1976 and prior to the fishery closure in 2012. Recreational catch and release angling is allowed but data is limited. The recreational fishery is believed to be minimal.[2] The MD DNR has monitored alewife and blueback herring from the Nanticoke River and other portions of Chesapeake Bay since 1980 and began monitoring the North East River spawning run in 2013.

Issues/Concerns

In 2013 a river herring ageing workshop took place to compare age estimates and methodologies among Atlantic coast states.[9] River herring age is determined from scales using the same methodology as for American shad (previously discussed), although some states also use otoliths for age determination. River herring of known age were not available to determine the accuracy of age estimates: obtaining accurate ageing is an imperative data gap. The workshop determined that age estimates of a fish tended to differ between labs, presumably due to different sample preparation and ageing methodologies. Otoliths were often aged younger than scales for young fish and aged older than scales for older fish. The extent of bias was affected by reader experience, species (alewife versus blueback), river system, and environmental conditions. Standardization of ageing methods and validation of scale ages are needed. At the Data Collection Standardization Workshop held in November 2015, it was recommended that paired otolith and scale samples should be collected from all fish sacrificed for biological sampling. [10]

Misidentification of river herring species is relatively common. Alewife and blueback are easily confused and can be confused with young hickory shad and American shad. At the Data Collection Standardization Workshop (November 2015) it was recommended that field identification should be validated, when possible, with a more rigorous laboratory-based method.[9]

River herring mortality sources include harvest, bycatch, discard, pollution, and predation. In Maryland, mortality from hydroelectric turbines is considered insignificant because they are rarely encountered in Conowingo Dam's fish lifts; less than 1,000 river herring per year have been passed upstream at Conowingo Dam since 2002.[3] Ocean trawl bycatch of juvenile river herring in the Atlantic mackerel and Atlantic herring fisheries is of particular concern.[1] Genetic studies indicate 78% of blueback herring bycatch from the New England Atlantic Herring fishery is of Mid-Atlantic origin.[11] The NEFMC and MAFMC will continue to address river herring as bycatch and incentivize avoidance by fishermen. Additional at-sea observer data would improve development of management benchmarks.

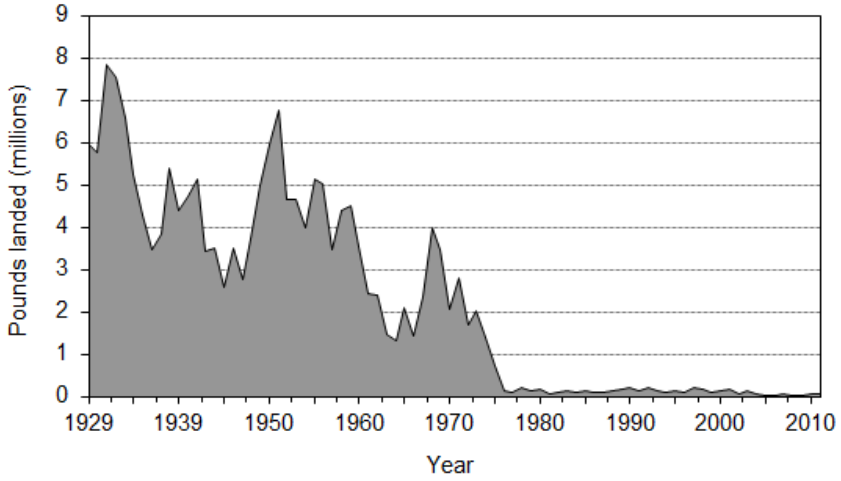
Adult access to suitable spawning habitat has historically been impeded by blockages of various types and sizes. Dams are a common type of barrier. Although building fishways has been an option for moving fish upstream, these structures are not a hundred percent efficient at passing fish. Removal of blockages is the preferred method for reopening spawning habitat. Maryland's Fish Passage Program is responsible for working on projects to reopen spawning habitat for anadromous fish. Most notably, recent dam removals on the Patapsco River have reopened substantial amounts of riverine habitat to alosine fish. Union and Simkins dams were removed in 2010, and the removal of Bloede dam was completed in 2019. More detailed

information can be found at:
http://dnr.maryland.gov/fisheries/pages/fishpassage/bloede.aspx.

The Fish Passage Program has updated its online Fish Passage Prioritization Tool and will continue working with partners to develop an incentive program for private dam owners to remove their dams.

The National Resources Defense Council petitioned the NMFS in 2011 to designate alewife and blueback herring as threatened species. In 2013, NMFS determined that the designation of either species as threatened or endangered was not warranted.[12] Following the determination not to list alewife and blueback herring as endangered species, NMFS, partnering with ASMFC, began an initiative to proactively conserve the coastwide population of river herring. This initiative established the TEWG, composed of individual experts from state and federal agencies, academia, the fishing industry, federally recognized tribes, and conservation organizations from the East Coast of the United States and Canada to provide knowledge and guidance for a coastwide conservation plan. In 2017, NOAA initiated a new status review for river herring to once again determine if listing under the Endangered Species Act is warranted. In addition to a rangewide assessment, NOAA conducted a status review of distinct population segments (DSPs) for each species. Four DSPs were identified for alewife: Canada, Northern New England, Southern New England, and Mid-Atlantic. Additionally, three DSPs were identified for blueback herring: Canada/Northern New England, Mid-Atlantic, and Southern Atlantic. In June 2019, NOAA determined that listing of either species, both rangewide or as specific DSPs, was not warranted at that time.[13]

Figure 1. Time series of commercial landings of shad river herring (alewife and blueback, 1929-2011) in Maryland.[3]



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1998 Amendment 1 to the 1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (09/2020)			
Strategy	**Action**	**Date**	**Comments**
1.1 1 The Bay jurisdictions will reevaluate the criteria for reopening a fishery in the Chesapeake Bay during the Alosid [*sic*] FMP revision process. Until new criteria are determined, the moratorium will remain in place for American and hickory shad in the Chesapeake Bay.	1.1 The Bay jurisdictions will continue the moratorium on American shad in Chesapeake Bay.	1989 Continue 2009 - 2011 Continue 2012 2014 2017	The Bay jurisdiction will reevaluate the criteria for reopening a fishery in Chesapeake Bay once a need for a revision of the FMP is designated. The coastal intercept fishery was closed December 2004. The Maryland moratorium remains in place for American and hickory shad. MD Sea Grant coordinated development of a Chesapeake Bay Ecosystem-based FMP. Chesapeake Bay jurisdictions continue to follow ASMFC requirements. http://www.asmfc.org/species/shad-river-herring PRFC developed an ASMFC approved sustainability plan for American shad. MD, DC, & VA developed ASMFC approved shad habitat plans. http://www.asmfc.org/files/ShadHabitatPlans/AmShadHabitatPlan_MD.pdf PRFC's sustainability plan for American shad underwent a 5 year review and was re-approved by ASMFC.
1.2 A special target-setting task force was charged to "establish measurable restoration targets" for American shad in the Bay. Eight spawning/nursery areas that historically supported substantial recreational and commercial fisheries were used to develop tributary-specific, quantitative recovery targets. The task force recommended that the stock recovery targets proposed for American shad be incorporated into the Alosid [*sic*] management plan.	1.2 The bay jurisdictions will incorporate the shad restoration targets into the revised Alosine FMP.	1999 2007 2008 2010 2012	River specific targets were proposed in 1997, but no action was taken. STAC held a 2007 workshop on Alosine targets. The white paper did not include targets. The CBP shad abundance index was expanded from the Susquehanna River to include the James, York, and Potomac Rivers. The index is based on fish passage on the Susquehanna and James Rivers, commercial bycatch CPUE on the Potomac River, and gill net CPUE on the York River. No relationship exists between adult and juvenile shad abundance limiting the usefulness of a JAI. Any relationship that may exist is masked by at-sea mortality. The CBP Sustainable Fisheries GIT revised the shad abundance indicator. The James River index was modified to include both lower James and Boshers Dam data. An index for the Rappahannock River was added. Indices for the York, Potomac, and Susquehanna rivers were not changed.

		2015	The Chesapeake Bay Program was tracking shad abundance when it was part of the 2000 Bay Agreement but with the completion of the 2014 Watershed Agreement, the shad abundance indicator is no longer being updated.

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (last updated 09/2022)			
Strategy	**Action**	**Date**	**Comments**
1.1.1 Removing the moratorium on Maryland American shad will not occur until the stocks of American shad in the upper Bay are fully recovered. Reestablishing a fishery will occur when annual population estimates in the upper Bay increase for three consecutive years and stock size reaches at least 50% of historical levels (approximately 500,000 fish) during one of those three years. Regulations will be established to ensure that initial annual exploitation in the upper Bay does not exceed 10% when the fishery is opened. Stock levels will be determined from an annual stock estimation study and exploitation rates will be established based on recreational and commercial surveys.	1.1.1 American shad abundance in the upper Bay has improved but has not sufficiently recovered to warrant an open fishery. American shad abundance is also low in other Maryland river systems. Maryland will continue the moratorium on American shad in the Chesapeake Bay.	1980 Continue 1982 Continue 1992 Continue 1998 2013	Shad stocks have fluctuated since the moratorium began in 1980. Spawning adult population is estimated annually for the Conowingo Dam tailrace. Population estimates for shad in the Upper Bay ended due to the loss of commercial pound nets in the Susquehanna Flats. Criteria to reopen the fishery have not been determined. Limited hickory and American shad bycatch harvest is allowed from the Potomac River pound net and gill net fisheries. PRFC has had a moratorium on directed shad harvest in Potomac River since 1982. DCFM implemented a moratorium on shad harvest within District of Columbia waters of the Potomac River in 1992. Amendment 1 to the CB Alosine FMP supersedes Strategy 1.1.1 restoration criteria No stock allocation for Alosa species has been developed due to the moratorium. Resource allocation will be revisited when Alosa stocks are deemed recovered.
1.1.2 Virginia will follow ASMFC recommendations for a 25% exploitation rate for alosids [*sic*].	1.1.2 Virginia will utilize the Virginia Marine Resources Commission's Stock Assessment Program and the fishery surveys of the Virginia Institute of Marine Science to assess current Alosid [*sic*] exploitation is above the 25% rate, Virginia will take the appropriate steps to limit fishing effort.	1994 Continue 2010 Continue	VA implemented a moratorium on the harvest of American shad from the Bay in 1994. ASMFC allows a limited American shad commercial bycatch harvest in the James, York, and Rappahannock rivers for the anchored and staked gill net fisheries. VA has an allowable catch for Native American tribes. PRFC adopted a moratorium on directed harvest of river herring for the Potomac River.

		2012 Continue	VA implemented a river herring moratorium January 1, 2012 as specified by ASMFC.
1.2 Maryland will recommend management of river herring on a system by system basis. Criterion for closing a system to river herring harvest will be based on juvenile indices from 1985 through 1989 and commercial harvests over the last 10 years. Maryland, Pennsylvania and Virginia will recommend that harvest from all systems slated for restoration be regulated or closed. Technical criterion will be submitted to ASMFC for reevaluation of the 0% exploitation rate for river herring in Maryland. In addition, Maryland will control the harvest of river herring by one or a combination of the following harvest limits; harvest season; areal closures; or gear restrictions. Virginia will use similar measures to control harvests of river herring, American shad and hickory shad.	1.2 River herring harvest will be controlled. Types of management actions which will be considered in the regulation of river herring are as follows: Harvest – Quotas would be a reasonable regulation if the size of the spawning stock in a given year was predictable Seasons – Setting a season during a segment of the "average" spawning period to regulate exploitation Areal closures – Restrict exploitation in those areas where the potential for harvest is greatest such as restricted portions of migratory routes or at migration barriers Gear restrictions – Restrict large-volume harvesting by pound nets and/or haul seines	2012 Continue 2012	Commercial harvest of river herring declined due to low market demand and uncertain stock status. Commercial and recreational river herring fisheries were closed on January 1, 2012. All river herring and river herring products imported into MD and VA must include a bill of sale. MD and VA do not have an ASMFC approved sustainable fishery plan for river herring. PA prohibited the harvest of river herring in the Susquehanna River watershed.
1.3 Maryland will continue the moratorium on the fishery for hickory shad and consider opening a recreational fishery when the American shad stocks have recovered.	1.3 Management actions and strategies for American shad and hickory shad will not be separated due to the paucity of information available for hickory shad and by nature their similar life history.	Continue 1994 Continue 2010 2014 2007	MD (1981) and DC (1992) and PRFC (1995) continue moratorium on hickory shad. Recent monitoring results suggest hickory shad are rebuilding in the Bay. Larval and juvenile hickory shad have been stocked in the Patapsco, Patuxent, Choptank, and Nanticoke rivers. Shad are no longer stocked in Marshyhope Creek (Nanticoke River). Stocking has been focused on the Choptank River. From 1994-2015, 44.5 million American shad and 111.6 million hickory shad have been stocked. Hickory shad are considered self-sustaining in the Patuxent River.

		2014	Hickory shad considered self-sustaining in the Choptank River.
1.4 Pennsylvania will continue to prohibit the harvest of American shad in the Susquehanna River and its tributaries, and American and hickory shad in the Conowingo Reservoir while restoration efforts are in progress.	1.4 As restoration of alosids [*sic*] progresses over dams in the Susquehanna River, additional regulations in Pennsylvania will be promulgated to protect these species until a degree of restoration is achieved	Continue Continue	PA prohibits the harvest of American and hickory shad in the Susquehanna River watershed. Insufficient recreational catch data are available post-2008. There is a recreational catch and release fishery below Conowingo Dam.
2.1 Maryland, Pennsylvania and Virginia will continue to participate in the ongoing ASMFC-coordinated coastal fishery stock identification and ocean landing studies of alosids [*sic*].	2.1 Maryland, Pennsylvania and Virginia will participate in the ongoing ASMFC alosid [*sic*] management program, both in Board and Scientific and Statistical Committee activities, with the goal of providing adequate protection to the component of the coastal stock which returns to the Chesapeake Bay to spawn.	Continue 1997 1999 2007 2008 2012 2012-2013 Continue 2014 Continue 2017	MD, VA, and PRFC participate in the ASMFC shad management board and technical committee. ASMFC conducted a stock assessment in 1997. Amendment 1 to the ASMFC shad plan adopted a strategy to keep fishing mortality below F_{30}. ASMFC Amendment 3 specified the American shad total mortality threshold to Z_{30} for the coastal stock. ASMFC completed a stock assessment in 2007. The ASMFC Review Panel recommended the development of population specific reference points. American shad and river herring mortality rates have increased. Alosa bycatch in ocean fisheries are contributors, but data is limited. Bycatch mortality in Chesapeake Bay has not been estimated. The ASMFC Management Board approved the 2012 river herring stock assessment. MAFMC adopted Amendment 14 which imposes a 520,000 lb Alosa bycatch limit to the Atlantic mackerel fishery. NEFMC has adopted Amendment 5 to the Atlantic herring FMP. Both amendments will improve bycatch reporting. MD and VA participated in the TEWG for river herring coordinated by NMFS and ASMFC to inform and develop a coastwide conservation plan for river herring. The ASMFC Management Board approved the 2017 river herring stock assessment update.

		2020	The ASMFC Management Board approved the 2020 American shad benchmark stock assessment. A more conservative total mortality threshold of $Z_{40\% SBPR}$ was recommended for coastwide stocks.
2.2 Virginia will follow ASMFC recommendations to reduce shad harvest to a 25% exploitation rate.	2.2 A) Implement a coastal shad tagging program to determine which stocks are being exploited in the intercept fishery	1991 Continue Continue	Tagging studies indicated that the coastal fishery is mixed and highly variable from year to year. Continuation of tagging programs is recommended. DNA data is used to identify populations within the mixed ocean stock. MD and VA obtain tissue samples for research upon request.
	2.2 B) Control the coastal intercept fishery through a combination of gear restrictions, seasonal and area closures, and harvest limits	2005 Continue	ASMFC Amendment 1(1999) required closure of the coastal intercept fishery by December 2004.
	2.2 C) Continue to monitor and document its territorial sea intercept fishery for American shad	1993 Continue	VA is required to monitor coastal commercial harvest.
2.3.1 Virginia will follow ASMFC recommendations to reduce river herring harvest to a 25% exploitation rate.	2.3.1 Virginia will control river herring harvest during spawning migrations through gear restrictions and spawning area closures.	1992 Continue 2012 Completed	The harvest of river herring has declined for a number of reasons including a loss of spawning habitat due to dams, commercial fishing, and as by-catch in the Atlantic herring and Atlantic mackerel ocean fisheries. Action 2.3.1 was superseded by the ASMFC's 2012 moratorium on river herring harvest.
2.3.2 Maryland and Virginia will ensure that river herring by-catch in the foreign and domestic mackerel fisheries is minimized.	2.3.2 Maryland and Virginia will monitor river herring by-catch through the mid-Atlantic Fishery Management Council and support the following recommendations: a) The foreign fishery will stay 20 miles offshore.	Continue Continue	River herring bycatch is monitored under Amendments 14 and 15 to the MAFMC Atlantic Mackerel/Squid/Butterfish FMP. NAFO monitors international fishing fleets.
	2.3.2.b) Maximum by-catch of 1% for river herring in the foreign and domestic mackerel fisheries with a cap on total allowable by-catch.	Continue 2019 Continue	River herring bycatch is monitored by the MAFMC, NEFMC, NMFS, and NAFO. The MAFMC approved an initial annual incidental shad and river herring catch cap of 89 mt for the Atlantic mackerel fishery for 2019-2021. The cap may increase if the fishery lands 10,000 mt of Atlantic mackerel without exceeding the initial 89 mt shad and river herring cap; if this occurs, the annual caps proposed for 2019, 2020, and 2021 are 129 mt, 152 mt, and 159 mt respectively. Conditions were met in 2019 to allow for the increase to 129 mt in 2020, where it has remained since.
	2.3.2 c) Intercept fisheries will be discouraged.	2012-2015 Continue	MAFMC under Amendment 14, approved an 180,779 lb Alosa bycatch limit to the Atlantic mackerel fishery for 2016-2018. NMFS has approved NEFMC Amendment 5 to the Atlantic herring FMP.

			Both amendments will improve at-sea observer bycatch reporting and monitoring. 2019 Continue Since 2019, the shad and river herring catch cap for the Atlantic herring fishery has been set at 361 mt coastwide. This quota was divided among four fishery regions/gears including the Gulf of Maine mid-water trawl (76.7 mt), Cape Cod mid-water trawl (32.4 mt), southern New England mid-water trawl (129.6 mt), and the southern New England bottom trawl (122.3 mt).
3.1 The jurisdictions will collect specific data on alosid [*sic*] species to improve stock assessment databases.	3.1 A) Maryland will continue the alosid [*sic*] juvenile survey and develop an index of stock abundance. Virginia will continue to collect shad and herring juvenile abundance data with the objective of developing a baywide index of abundance for these species. (Currently being implemented) The juvenile index will be used in conjunction with adult stock estimates to trigger regulatory changes and harvest rates.	Continue Continue 2010 Discontinued	VIMS, MD DNR and DCFM have Alosine juvenile surveys and calculate indices for each species. http://dnr.maryland.gov/fisheries/Pages/striped-bass/juvenile-index.aspx ASMFC Amendment 2 requires river herring JAI surveys. VA & MD continue to provide data to coastal stock assessment Preliminary stock recruit indices for river herring were developed and presented to the ASMFC's Herring Stock Assessment Sub-committee (SAS). The effect of bycatch, environmental factors, and stock change on the relationship requires further study. No trends were detected for American shad and there was insufficient data for hickory shad. Initial stock-recruit analyses indicated that a river herring JAI was a predictor of future year class strength. The SAS decided not to pursue development of the indices.
	3.1 B) Maryland will continue research projects for American shad in the upper Bay and Nanticoke River which provide annual estimates of adult shad. (Currently being implemented)	Discontinued 2009 Continue 2011 Continue 2013 Continue	Adult shad tagging project on the Nanticoke River was ended due to a lack of tag returns. ASMFC Amendment 2 requires adult river herring spawning/population assessment. The Nanticoke River commercial survey is the data source for the river herring spawning population assessment. The Nanticoke River commercial survey will continue during the moratorium. A fishery independent gill net survey was conducted in the North East River to monitor spawning river herring.
	3.1 C) Virginia will improve assessment of current fishing rates on shad stocks in territorial waters and seek to improve catch and effort data through mandatory reporting. (1990)	1995 Continue	Commercial landing data have been improved on a coastwide basis with the establishment of ACCSP. Limited American shad bycatch fisheries exist.

	3.1 D) The VMRC Stock Assessment Program will provide additional fishery dependent data collection for Virginia's shad fisheries (on-going)	Continue	Required by the ASMFC.
	3.1 E) Virginia will initiate an ocean intercept tagging program to determine stock composition in the coastal shad fishery (1990)	1991-1992 Completed 2005	Tagging work completed in 1992. Results indicated coastal catch is mixed and highly variable. Ocean intercept shad fishery was closed.
	3.1 F) Maryland will examine the exploitation rates of alewife and blueback herring in selected tributaries of the Chesapeake Bay and improve the accuracy and utility of herring landings. (1990)	1990 Continue Continue	Mortality rates are calculated for river herring in the Nanticoke River. Exploitation rate estimation has not been a priority. MD began a moratorium on river herring in 2012.
	3.1 G) Virginia will cooperate with research institutes to implement a survey of selected shad and herring spawning grounds, compiling information on basic spawning stock characteristics including relative adult abundance, juvenile abundance, size, age and sex ratios. (Currently being implemented)	1990 Completed 1995 2009 2009 Continue	A map of historic shad and herring spawning areas has been completed. Tributary-specific targets were considered. The FMPC and ad hoc Fish Passage workgroups met to discuss how to address the development of targets. No targets were adopted. CBSAC sponsored a workshop to evaluate different methodologies and recommended a multi-metric approach. ASMFC Amendment 2 requires adult river herring spawning/population assessment and Amendment 3 (2010) requires adult American shad spawning/population assessment.
	3.1 H) American shad abundance will be investigated in the Potomac River, a system of historic importance, through a joint effort by Maryland, Virginia, and District of Columbia. (1991)	Continue 1991 Continue 2011 Continue 2019 Continue	MD striped bass juvenile seine and gill net surveys collect American shad data. DCFM has been sampling the upper Potomac for shad and river herring since 1991. The juvenile survey on the Potomac indicates shad are increasing in abundance especially since 2000. The abundance of juvenile Alosa spp is highly variable and involves density dependent processes that regulate year class strength. The PRFC American shad pound net survey indicates that CPUE in the Potomac River has exceeded the CBP restoration target since 2011.
4.1 The Chesapeake Bay Program's Fish Passage Workgroup has analyzed the problem of impediments to Alosid [*sic*] migration and	4.1 The District of Columbia, Maryland, Pennsylvania and Virginia will implement the plan adopted by the Fish Passage Workgroup to remove barriers. Projects include:	Variable 1991	Actions 4.1A - 4.1C, 4.1E, and 4.1G - 4.1I have been completed. Actions 4.1D, 4.1F, and 4.1J – 4.1L are underway. Conowingo Dam East Fish Lift is operational.

presented its recommendations for acceptance in December 1988. Maryland will develop a multi-faceted program based on the program's recommendations to restore spawning habitat to migratory fishes by removing blockages. Virginia, through its Anadromous Fish Restoration Committee, will develop a comprehensive inventory of dams and other impediments restricting the migration of the shad and river herring to their historical spawning grounds and establish fish passage facilities. The Pennsylvania Fish and Boat Commission (PFBC) will continue to refine its inventory of low head dams through SRAFRC and continue to promote fish passage at structures on the Susquehanna River tributaries having the potential for Alosid [*sic*] spawning and nursery habitat. Maryland, Virginia, District of Columbia, U.S. Fish and Wildlife Service and Corps of Engineers will continue its work for fish passage at Little Falls and Rock Creek.	A) Permanent fish passage facilities are being designed and will be constructed at Conowingo Dam at a cost of $12.5 million. (1989)	2010 2011 Continue 2012 2009 - 2012 2014 Continue 2016 2019	SRAFRC adopted the Migratory Fish Management and Restoration Plan for the Susquehanna River Basin in 2002, which was revised in 2010. This plan sets restoration goals for all Alosine species. The last significant blockage in MD for spawning American shad passage is the Conowingo Dam. Shad passage at Conowingo is being evaluated as part of the FERC relicensing process. Shad upstream passage efficiency at Conowingo was estimated in 2010 at 45% and in 2012 at 26%. American shad telemetry study detected fall-back behavior, where many fish enter the East Fish Lift, but leave without passage. Conducted fish passage and habitat studies as part of the FERC relicensing process. FERC renewed the license for the Conowingo Project in early 2021. Exelon has come to an agreement with USFWS for improvements of fish passage at Conowingo Dam. The planning and modeling for these improvements began in 2017/2018, and with the approval of the relicensing, construction is scheduled to begin in 2022. Maryland Department of the Environment issued a Water Quality Certification with special conditions for the proposed relicensing of the Conowingo Dam in April 2018 that would require Exelon to implement changes in flow to improve conditions for downstream aquatic life and increase fish migration upstream. Shortly thereafter, Exelon challenged the Certification in state and Federal courts. Maryland Department of the Environment reached a settlement agreement with Exelon Generation Co LLC in October 2019. Exelon agreed to invest more than $200 million in environmental protection, mitigation, and enhancement measures over the 50-year term of the new license.
	4.1 B) Design planning and implementation of fishways at Holtwood, Safe Harbor and York Haven dams on the Susquehanna River. (In progress)	1986 Completed 2010 Continue	Fishways have been constructed. Fishway improvements are periodically implemented to boost fish passage efficiency. Holtwood Dam fishway is being renovated to improve upstream passage of Alosa. All improvements were completed by 2015.

		2015 Continue	Plans to construct a "nature-like" fishway at York Haven dam have stalled. York Haven Power Company (YHPC) has cited the high cost of the negotiated design as prohibitive to the completion of the project. Resource agencies are currently negotiating a path forward with YHPC.
		2020 Continue	The operation of fishways is currently being impacted by the proliferation of invasive species in the Susquehanna River basin. Conowingo dam is currently a major barrier to the spread of both Blue catfish (*Ictalurus furcatus*) and Northern Snakehead (*Channa argus*). In response to the increasing presence of these species in the Conowingo Dam tailrace, volitional passage via fish lifts at Conowingo was suspended. Instead, shad and river herring collected in the fish lifts will be trucked and transported to suitable spawning habitat upstream of either the Safe Harbor Dam or York Haven Dam.
	4.1 C) A comprehensive inventory of dams and other impediments restricting the migration of shad and river herring to their historical spawning grounds has been completed. (1989)	1990	Action completed.
		2011/2012	The Nature Conservancy in conjunction with NOAA, USFWS, MD DNR, PA FBC, VDGIF, CBP, USACE, American Rivers, VCU, and Chesapeake Bay Trust completed a GIS based Chesapeake Fish Passage Prioritization tool to prioritize dam removal based on ecologically relevant metrics.
		2014	The tool is currently being used and was updated in 2018. The online mapping tool can be found at: https://maps.freshwaternetwork.org/chesapeake/
	4.1 D) Removal of stream blockages, re-stocking efforts, and construction of fish ladders at sites of barriers on priority streams and rivers will begin. (1990)	Continue	1,838 miles of Chesapeake Bay stream habitat was reopened in PA, VA, and MD for anadromous fish from 1988 through 2005.
		1989-2007 Continue	VA has removed 6 dams, breached 3, and built passage structures at 9 as of 2015. Several fish passage projects are being pursued. VA dam removal status is available at http://www.dgif.virginia.gov/fishing/fish-passage/
		2009	Between 1989 and 2013, approximately 2,576 miles of habitat were reopened to anadromous and resident fish.
		Continue	From 1986 to 2003, >340 million American shad fry and fingerlings were cultured and released in Susquehanna, James, Pamunky, Mattaponi, Rappahannock, Potomac & Choptank rivers. Rappahannock River stocking began in 2003.

		2011-2013 Completed	Patuxent River hickory shad have been restored and stocking discontinued. Limited monitoring will continue. Marshyhope stocking was discontinued after 2011. Choptank River hickory shad have been restored and stocking discontinued. American shad are only stocked in the Choptank River as of 2011.
		2010 Continue	Additional wells were drilled at Manning hatchery and liners added to existing ponds to accommodate increased river herring culture.
		2010	Union Dam and Simkins Dam on Patapsco River were removed.
		2018-2019	Bloede Dam was breached in fall 2018 and complete restoration of the streambed and riparian areas was completed in summer 2019. The removal of these dams has re-opened approximately 60 miles of aquatic habitat for migratory fish.
		2015	Experimental stocking of American shad, hickory shad, and river herring in the Patapsco River began in 2013. 542,600 alewife, 290,000 American shad, 200,000 blueback, and 615,000 hickory shad were stocked in 2015.
		2014 Continue	The 2014 CB Watershed Agreement (prompted by Executive Order 13508) included an outcome for opening 1,000 miles of migratory fish passage by 2025 (baseline mileage 2,041).
	4.1 E) A demonstration fish ladder project has been developed with the Chesapeake Bay Foundation and the town of Elkton as an example with public access. (1989)	Completed	Elkton dam fishway was built in 1993. Thousands of herring and resident fish have used the fishway to access 12 miles of upstream habitat for spawning, forage, and cover. Fish Passage staff documented over 7,000 alewife and blueback herring using the fishway in 1999.
		2005	Town of Elkton created a bypass channel around the dam which increased from bank incision and erosion upstream. Sediment accumulation has increased at the entrance and exit of the fishway that must be dredged roughly every 2 years. The number of herring using the fishway has significantly decreased since 2005, which corresponds with the time frame for the coast wide decline of both shad and herring.
		2009	In 2009, there was some evidence of river herring spawning upstream of the Elkton Dam.
		2014	In 2014, river herring were observed below the fish ladder but sediment deposits are inhibiting fish from using the ladder. The town

			of Elkton is responsible for maintaining the ladder and will make provisions for improving access when their MDE permit is renewed in 2016.
	4.1 F) A program to reduce turbine mortalities by implementing guidance and avoidance techniques, i.e., use of fish attraction or avoidance devices to guide shad away from turbines to "sluice gate" (1991).	1992 1994 1997 2001 2009-2013 Completed	YOY American shad survival from passage through a Kaplan turbine (Conowingo Dam) is 95%. YOY shad survival was 90% for a single runner Francis turbine at Holtwood Dam. YOY shad survival at double runner Francis turbines was 77% at York Haven Dam and 83% at Holtwood Dam. Exelon Generating Company LLC funded a study to estimate YOY American shad mortality from a single runner Francis turbine at Conowingo Dam during the FERC relicensing process. YOY survival was 90%. Entrainment of adult, out-migrating American shad is projected to be high. Adult shad survival is 80-90% at Francis turbines and 84% at Kaplan turbines.
	4.1 G) Fish passage facilities on the James and Rappahannock Rivers will be established. (Currently being implemented)	1999 Completed 2005 Completed	Vertical slot fishway completed at Boshers Dam on the James River, the last in the fall zone of Richmond. This reopened 137 miles of the mainstem James and over 150 miles of major tributaries. Embrey Dam was removed from the Rappahannock River reopening 106 miles of the Rappahannock and Rapidan rivers.
	4.1 H) The recently constructed passage facility on the Chickahominy River at Walker's Dam will be evaluated for its effectiveness. (1990)	1989 Completed	A double Denil fishway on Walkers Dam was rebuilt in 1989 by the City of Newport News to allow passage of migratory fish. Alosa, blueback herring, alewife and American shad have been documented using the fishway.
	4.1 I) Fish passage facilities at Little Falls Dam on the Potomac River will restore about 10 miles of spawning habitat and at Rock Creek park will open an additional 5 miles of spawning habitat.	1999 - 2000 Completed	A hydraulic model and construction of Little Falls Dam fish passage has been completed. Fish passage effectiveness has been difficult to measure.
	4.1 In addition to the strategies detailed in the Fish Passage Plan, several aspects must be coordinated with the Fishery Management Plan: J) Sources of adult fish used for restocking areas will be coordinated with other states and agencies. (1990)	Continue Continue	Hatchery-rearing methods are standardized. MD, VA, and PA strip spawn. DE hatchery spawning is hormone free. Jurisdictional coordination is good. All American shad broodstock used by MD, VA, PA, and USFWS are from the Potomac River. MD stocks larval, early juvenile, and late juvenile stages to improve stocking success rate. PA stocks some American shad from the Delaware and Susquehanna Rivers.
	4.1 K) The reintroduction of alosid [*sic*] stocks will require specific regulatory measures to protect the newly-introduced fish until populations have been established.	Continue 2010	Moratorium in place for American and hickory shad. Hickory shad data is insufficient for most tributaries to determine population status. Juvenile downstream survival must be improved at dams having Francis turbines: Holtwood and York Haven.

		2011 2013	Normandeau studies at Safe Harbor (2008) and Conowingo (2012) indicate ~86% survival of adult American shad during downstream passage. Moratorium is in place for river herring. Allocation of shad and herring resources among stakeholders has been deferred until the species stocks are declared restored.
	4.1 L) Monitoring is essential in gauging the impact of fish passage projects on restoration efforts.	1999 Continue Continue Continue	ASMFC Amendment 2 encourages assessment of fishway passage efficiency/inefficiency for river herring. Boshers Dam vertical slot fishway is monitored for passage each spring. American shad plus 23 other species are known to use the passage. Fishways are monitored on a limited basis as new ladders are constructed. A 10-year fish passage monitoring goal of 50% coverage is being considered. Fishway efficiency has been difficult to measure. Passage indices should be explored.
4.2 Restoration of shad and river herring to suitable unoccupied habitats will be accomplished by introducing hatchery-raised juveniles or transplanting gravid adults. Present policy fully supports the transplantation of adult shad using fish passage facilities at Conowingo Dam under the assumption of reasonable outmigration. However, if outmigration is not obtained, then the effects of transporting adults from the population below the dam needs to be reevaluated.	4.2.1) Maryland and Pennsylvania will continue to work within SRAFRC's ongoing programs as described in the annual work plan to evaluate methods for ensuring successful downstream passage for juveniles and adults. This will include spill, diversion devices, and bypass systems.	Continue 2002 2010 2015	SRAFRC adopted a new Alosine Management and Restoration Plan for the Susquehanna River Basin in 2002. Restoration Plan was revised in 2010 http://www.dec.ny.gov/docs/fish_marine_pdf/r7fsrafcfinal.pdf Plans to construct a "nature-like" fishway at York Haven dam have stalled. York Haven Power Company (YHPC) has cited the high cost of the negotiated design as prohibitive to the completion of the project. Resource agencies are currently negotiating a path forward with YHPC.
	4.2.2 A) Maryland, Pennsylvania, and Virginia working within SRAFRC, will promote using Susquehanna River brood stock for hatchery production.	Discontinued 2002 Continue Continue	Brood stock are no longer collected from the Susquehanna River. MD, VA, PA, and USFWS use American shad brood stock collected from the Potomac River. 10% of eggs collected from Potomac River brood stock must be returned to the Potomac as mitigation for egg removals. Susquehanna River American shad spawned at MD hatcheries have had poor fertilization rates. Funding is not available to determine the cause. Population level impact of poor fertilization rates in the wild stock [*in situ*] has not been determined. Normandeau Associates, Inc. spawns Susquehanna River American shad for experimental stocking in PA. The fish are collected at the Conowingo Dam's west fish lift.

	4.2.2 B) Virginia will expand funding to the recently constructed Pamunky/Mattaponi Indian Reservation shad hatcheries.	1993 Continue	Funding was from VMRC but is now provided by VDGIF.
4.3.1 Technical issues concerning water quality standards for dissolved oxygen and minimum flows in the Susquehanna River below Conowingo Dam have been negotiated.	4.3.1 The following technical issues have been accepted. A) Adoption of Maryland water quality standard for dissolved oxygen of 5.0 mg/liter in the Susquehanna River below Conowingo Dam (1989)	Continue 2018	Standards were implemented in 1989 and have been monitored ever since. New water quality criteria for living resources have been adopted. Water quality sampling protocols are being reviewed during the FERC relicensing process. Maryland Department of Environment issued a Water Quality Certification that would require Exelon to implement changes in flow to improve conditions for downstream aquatic life and increase fish migration upstream
	B) Installation of turbine venting systems and intake air injection capabilities (1991)	1988 – 1991 Completed	All 7 Francis turbines now have turbine venting systems and partial intake air injection system.
	C) Operation of turbines as necessary to meet the DO standard (1989)	Continue	Power generation is adjusted as needed.
	D) Monitored spills as necessary (1989)	Continue	Water releases are closely monitored to maximize pool volume.
	E) A schedule of minimum and continuous flows (1989)	Continue	The dam and reservoir are managed to meet required water flows. However, the minimum flow (cfs) was not continuously maintained, but rather allowed to fluctuate below the minimum within the management window. As part of the FERC relicensing, Exlon agreed to increase minimum flows at the dam.
4.4 MD DNR has proposed new criteria for use in the revised water use classification and water quality standards system setting standards for temperature, dissolved oxygen, pH, amount of suspended solids and a number of "priority pollutants" in anadromous fish spawning areas.	4.4 Establish new categories in the water classification system to guide resource management based on the physical habitat and water quality characteristics. The revised system would define anadromous fish spawning areas as either Class II waters (fresh, nontidal warm water streams, creeks and rivers) or Class III waters (tidal estuarine waters and Chesapeake Bay).	2007 2011 2014 Continue	Maps delineating particular habitats of concern are used for developing water quality standards. Revised habitat prioritization maps have been completed by CBP. Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf
4.5 The District of Columbia, Maryland, Pennsylvania and Virginia will cooperatively evaluate the available scientific data on the effects of impaired water quality on alosids [*sic*] as a means of developing more effective water quality criteria for spawning and hatching areas	4.5) The first three action items are commitments under the 1987 Chesapeake Bay Agreement. MD DNR, PFBC, DC and VMRC will not carry out the specific commitments but are involved in setting the objectives of the programs to fulfill the commitments and reviewing the results of the action programs. The achievement of these commitments will lead to improved water quality and enhanced biological production.	Continue Variable 2000	Chesapeake Bay Program develops, revises, and monitors goals and strategies for nutrients, wastewater, sediment, stormwater, agriculture, development, and chemical contaminants. For more information: https://www.chesapeakebay.net/issues New commitments were established in the Chesapeake 2000 Agreement. For Alosines, priority populations will be identified and tributary-specific targets developed.

and take action now to reduce pollution from several sources.	A) Develop and adopt a basinwide plan that will achieve a 40% reduction of nutrients entering the Chesapeake Bay by the year 2000. 1) Construct public and private sewage facilities. 2) Reduce the discharge of untreated or inadequately treated sewage. 3) Establish and enforce nutrient and conventional pollutant limitations in regulated discharges. 4) Reduce levels of nutrients and other conventional pollutants in runoff from agricultural and forested lands. 5) Reduce levels of nutrients and other conventional pollutants in urban runoff.	2007 2009 2009 2010 2012 Continue 2014 Continue	STAC sponsored a workshop during 2007 to develop restoration targets. Executive Order 13508 by President Barack Obama required federal agencies to increase cooperation and leadership, coordinate with state and local government, and enforcement of Clean Water Act. EPA is mandating restoration criteria and actions for Chesapeake Bay States. EPA developed a Chesapeake Bay watershed TMDL. States must have EPA approved plans with 2-year milestones or face fines and other sanctions. Various jurisdictions have filed legal challenges to the EPA TMDL. Jurisdictions submitted Phase I watershed implementation plans (WIP) in 2010 and Phase II WIPS in 2012 Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf
	4.5 B) Develop and adopt a basinwide plan for the reduction and control of toxic materials entering the Chesapeake Bay system from point and nonpoint sources and from bottom sediments. 1) Reduce discharge of metals and organic compounds from sewage treatment plants receiving industrial wastewater. 2) Reduce the discharge of metals and organic compounds from industrial sources. 3) Reduce levels of metals and organic compounds in urban and agriculture runoff. 4) Reduce chlorine discharges to critical finfish areas.	Continue 2014 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for chemical contaminants. For more information: http://www.chesapeakebay.net/issues/issue/chemical_contaminants Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf
	4.5 C) Develop and adopt a basinwide plan for the management of conventional pollutants entering the Chesapeake Bay from point and nonpoint sources. 1) Manage sewage sludge, dredge spoil and hazardous wastes. 2) Improve dissolved oxygen concentrations in the Chesapeake Bay through the reduction of nutrients from both point and nonpoint sources. 3) Continue study of the impacts of acidic conditions on water quality.	2011 2008 Continue	Some Alosa spawning reaches appear to be sand and gravel deficient and may impair egg survival. MD DNR and USACE are studying sand and gravel transport at the Simkins Dam removal site (Patapsco River) as well as possible negative effects of accumulated sand and gravel behind blockages. MD DNR Fishing and Boating Services is studying spawning and hatching success with associated habitat and watershed conditions including land use. Analyses indicate that urbanization is detrimental to Alosine spawning.

	4) Manage groundwater to protect the water quality of the Chesapeake Bay. 5) Continue research to refine strategies to reduce point and nonpoint sources of nutrient, toxic and conventional pollutants in the Chesapeake Bay.	2014 Continue 2018 Continue	Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf Sediment retention behind Conowingo Dam is at capacity. The dam no longer reduces sediment, nutrient and other pollutant inputs to Chesapeake Bay. Options being considered for sediment removal and disposal include sediment bypass, quarry infill, use as landfill material, construction material, and Blackwater Wildlife Refuge marsh restoration. High flow events (storms) scour significant quantities of the stored sediment.
	4.5 D) Develop and adopt a plan for continued research and monitoring of the impacts and causes of acidic atmosphere deposition into the Chesapeake Bay. This plan is complemented by Maryland's research and monitoring program on the sources, effects, and control of acid deposition as defined by Natural Resources Article Title 3, Subtitle 3A, (Acid Deposition: Sections 3-3A-01 through 3-3A-04). 1) Determine the relative contributions to acidic deposition from various sources of acid deposition precursor emissions and identify any regional variability. 2) Assess the consequences of the environmental impacts of acid deposition on water quality. 3) Identify and evaluate the effectiveness and economic costs of technologies and non-control mitigative techniques that are feasible to control acid deposition into the Bay.	Continue 2014 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for air pollution. For more information: http://www.chesapeakebay.net/issues/issue/air_pollution Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf

Acronyms

ACCSP – Atlantic Coastal Cooperative Statistics Program
ASMFC – Atlantic States Marine Fisheries Commission
CBAMP – Chesapeake Bay Alosa Management Plan
CBP – Chesapeake Bay Program
CBSAC – Chesapeake Bay Stock Assessment Committee
Cfs – Cubic feet per second
CPUE – Catch per unit effort
DCFM – District of Columbia Fisheries Management
DO – Dissolved oxygen
EPA – Environmental Protection Agency
FERC – Federal Energy Regulatory Commission
FMP – Fishery Management Plan
GIS – Geographic information system
GIT – Goal implementation team
GM – Geometric mean
JAI – Juvenile abundance index
MAFMC – Mid-Atlantic Fisheries Management Council
MD DNR – Maryland Department of Natural Resources
NAFO – Northwest Atlantic Fisheries Organization
NEFMC – New England Fishery Management Council
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
PA FBC – Pennsylvania Fish and Boat Commission
PFC – Pennsylvania Fish Commission
PRFC – Potomac River Fisheries Commission
SAS – Stock assessment sub-committee
SRAFRC – Susquehanna River Anadromous Fish Restoration Committee
STAC – Chesapeake Bay Program, Scientific and Technical Advisory Committee
TEWG – Technical Expert Working Group
TMDL – Total maximum daily load
USACE – United States Army Corps of Engineers
USFWS – United States Fish and Wildlife Service
VCU – Virginia Commonwealth University
VGIF – Virginia Game and Inland Fish
VIMS – Virginia Institute of Marine Science
VMRC – Virginia Marine Resource Commission
WIP – Watershed implementation plan
YOY – Young of year

2021 Maryland FMP Report (December 2022)
Section 3. Atlantic croaker (*Micropogonias undulatus*) and Spot (*Leiostomus xanthurus*)

In February of 2020, the Atlantic State Marine Fisheries Commission (ASMFC) Sciaenids Management Board approved addenda for both Atlantic croaker and spot that made improvements to the Traffic Light Analysis (TLA). Management responses to either TLA triggering were established. The 2020 evaluation of the revised TLAs indicated both Atlantic croaker and spot triggered management action at the lower level. Maryland and the Potomac River Fisheries Commission (PRFC) had regulations in place for Atlantic croaker that satisfied the ASMFC management required by the addendum. Virginia instituted the necessary regulation for Atlantic croaker and all Bay jurisdictions instituted the necessary regulations for spot, with the exception of the PRFC commercial fishery, which requested, and was granted, de minimis status. The Atlantic croaker and spot technical committees evaluated the TLAs in 2022 with data through 2021, but data limitation due to Covid-19 precluded a complete evaluation. The regulations triggered for both species will remain in place through at least the 2023 fishing season.

Fishery Management Plans (FMPs)

The Chesapeake Bay Atlantic Croaker and Spot Fishery Management Plan (CBCS FMP) was adopted in 1991. The FMP's goal is to: "Protect the Atlantic croaker and spot resource in the Chesapeake Bay, its tributaries, and coastal waters, while providing the greatest long term ecological, economic, and social benefits from their usage over time." To accomplish this goal, management strategies were developed to prohibit the harvest of small fish (age 1 and younger) of both species and to recommend monitoring and research programs for stock assessments and habitat needs. The CBCS FMP was reviewed in 2014 by the Maryland Plan Review Team. It was determined that the plan is an appropriate framework for managing the Atlantic croaker and spot resources. The team recommended that the plan be reviewed again after the completion of coastal stock assessments and the development of new management triggers. However, the Maryland FMP review process is no longer being implemented.

The ASMFC adopted coastal FMPs for each species in 1987. The main purpose of the plans was to decrease the number of small fish caught as bycatch in the coastal shrimp trawl fishery. Bycatch reduction devices were required in the offshore coastal areas and have been successful at reducing the number of small fish caught in the trawl fishery. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Croaker was adopted in November 2005 and replaced the original FMP. The amendment established a spawning stock biomass target and threshold.[1] Addendum I (2010) to Amendment 1[2] modified the management area and biological reference points. Addendum II (2014)[3] established a precautionary management framework using the Traffic Light Approach (TLA), and Addendum III (February 2020)[4] modified the TLA and stated what management action would be required if the TLA were to trip.

An Omnibus Amendment to the Interstate Fishery Management Plans for Spanish Mackerel, Spot, and Spotted Seatrout was adopted in 2011 to allow these species to be managed under the authority of the Atlantic Coastal Fisheries Cooperative Management Act.[5] Addendum II to the Omnibus Amendment to the Interstate Fishery Management Plans For Spanish Mackerel, Spot, and Spotted Seatrout (2014) established a precautionary management approach by establishing and using a TLA for spot, and Addendum III (February 2020) modified the TLA and stated what management action would be required if the TLA were to trip. The first coastwide management requirements for both Atlantic croaker and spot were triggered following the 2020 TLA evaluations.

Atlantic Croaker Management — Biological reference points (BRPs) were established for Atlantic croaker in the mid-Atlantic region in 2005. The BRPs were revised in 2011 (Addendum I) following the 2010 ASMFC stock assessment and applied to the Atlantic coastal stock.[1] The BRPs set targets for fishing mortality (F) and spawning stock biomass (SSB) and are ratio-based. For the threshold, if $F/F_{MSY}=1$, overfishing is occurring. If $SSB/ (SSB_{MSY} (1-M)) =1$, the coastal stock is overfished. The 2011 ASMFC Atlantic Stock Assessment Technical Committee evaluated the stock assessment triggers in 2014 and found no evidence to support changing management.[6] The 2013 ASMFC Action Plan called for the development of an addendum to consider alternate Atlantic croaker trigger mechanisms. Existing management triggers were not considered an effective method to respond to changes in the fisheries. The Atlantic Croaker technical committee supported a new approach – a traffic light analysis – to evaluate the fishery.[3] The traffic light approach (TLA) was approved in Addendum II to Amendment 1 of the Atlantic Croaker FMP (August 2014).[3] The TLA incorporates multiple data sources into a single metric to provide management guidance. The TLA is useful for data-poor species management and replaces past assessment triggers. ASMFC approved adjustments to the TLA methodology in 2020 that were recommended by the Atlantic Croaker Technical Committee. Additional indices were added and grouped by region (Mid-Atlantic and South-Atlantic), the triggering mechanism was changed to three out of the four most recent years, and coastwide harvest reductions will occur if the TLA triggers management action.[4] The revised TLA triggered management action for Atlantic croaker in the Mid-Atlantic region (in which the Chesapeake Bay resides) in October of 2020. All non de minimis status states without a season or size limit in place were required to put in place a 50 fish bag limit and a 1% reduction to the previous 10 year

average harvest. Maryland had commercial and recreational limits in place, PRFC had recreational limits in place and requested and received de minimis status for their commercial fishery, and Virginia instituted a 50 fish bag limit and a commercial closure from January 1 to January 15.

Maryland is required to submit an annual ASMFC Atlantic croaker compliance report. This report describes the fishery management program for Atlantic croaker, including fishery dependent and independent monitoring, regulations, commercial harvest reports and recreational catch estimates.[7] Juvenile indices (seine and trawl) for the Maryland portion of the Chesapeake Bay have been calculated for every year since 1959. Maryland started a gill net survey in the Choptank River to sample adult Atlantic croaker and spot in 2013.

Atlantic Croaker Stock Status — Atlantic croaker is considered a single stock along the Atlantic coast. The 2017 ASMFC benchmark stock assessment was presented to the South Atlantic Board in May 2017.[6] The assessment was not endorsed for management use by the independent peer review, but they agreed with the SAS that immediate management action was not required. The review panel also recommended the continued use of the TLA until an improved assessment could be completed. Analysis of the revised TLA metrics (Addendum III) for 2020 (data through 2019) indicated that the population characteristic (commercial and recreational landings) 30% threshold was met for the sixth year in a row in the Mid-Atlantic region, and the proportion of red in 2018 and 2019 exceeded the 60% threshold, with 2019 being the highest of the 1981-2018 time series. The adult abundance characteristic in the Mid-Atlantic was above the 30% red threshold for the 10th consecutive year, so management action was triggered. If the TLA triggers in either region, management action is required coastwide. The 2022 evaluation, with data through 2021, was limited by missing data due to the Covid-19 pandemic and a gear change by the ChesMMAP survey that necessitated calibration factors that were not done in time for the 2022 evaluation. The available data indicates commercial and recreational harvest remained very low in both regions. The adult abundance indicators could not be updated for the Mid-Atlantic region, but the South Atlantic data did show some improvement. The TC anticipates having the full ChesMMAP time series available to make a full evaluation in 2023.

Atlantic croaker age and length data were analyzed from fish captured in Maryland pound nets from 1999 to 2021. Lengths and ages were taken from 973 and 155 Atlantic croaker, respectively in 2021. Age and length structure has been truncated to younger and shorter fish in recent years, with no age four plus fish sampled in 2021. Juvenile indices in Maryland had been below average from 2013 to 2018, but 2019 through 2021 index values were near or above the long term mean, which could lead to improved overall abundance, and improved age and size structure in the near future.

Atlantic Croaker Fisheries — Commercial landings from Maryland and Virginia followed a similar trend (Figures 1 and 2) with periods of high harvest in the 1950s, late 1970s, and late 1990s through the 2000s.[8] Commercial landings have declined steadily in recent years. Maryland's 2021 landings were 6,934 pounds (lbs) and Virginia 2021 landings were 397,643 lbs; both were the lowest values recorded since the early 1990s (NMFS data). Recreational harvest and release estimates from the Marine Recreational Information Program (MRIP) are higher for Virginia than Maryland for the majority of years, and decreased in both states in 2021 following a modest increase in 2020 (Figures 3 and 4).[9] Maryland recreational releases increased in 2020 and were similar to 2019 in Virginia, potentially indicating a continued increased availability of smaller Atlantic croaker.

Figure 1. Maryland commercial landings of Atlantic croaker from 1950-2021.[8]

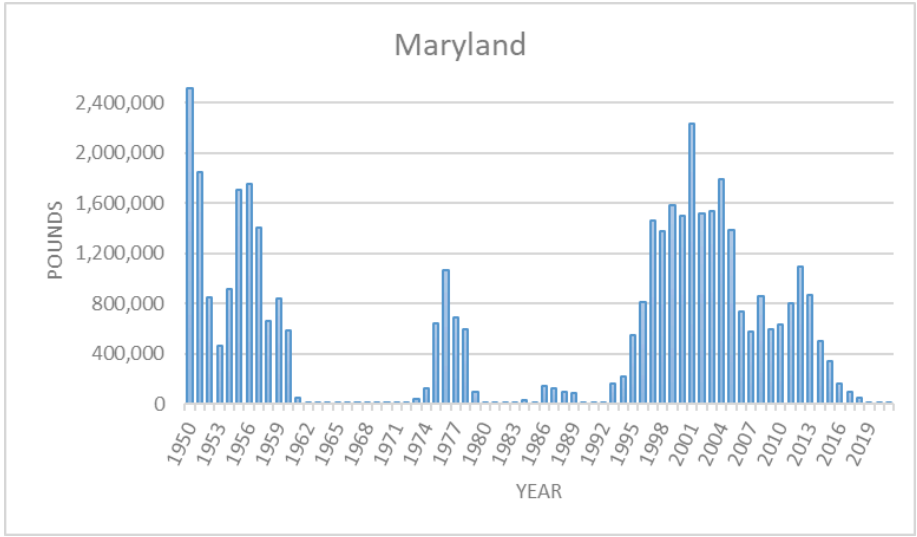


Figure 2. Virginia commercial landings of Atlantic croaker: 1950-2021.[8]

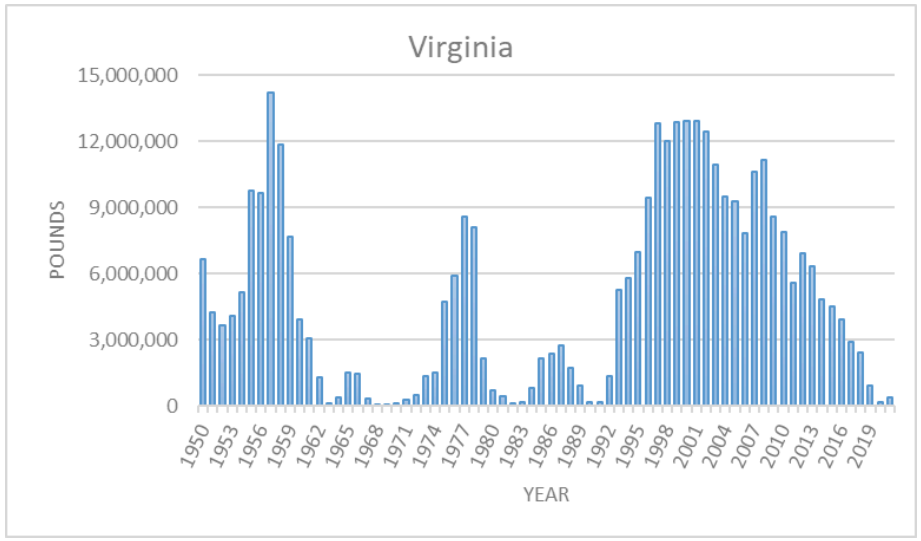


Figure 3. Maryland estimated recreational harvest and release for Atlantic croaker: 1981-2010.[9]

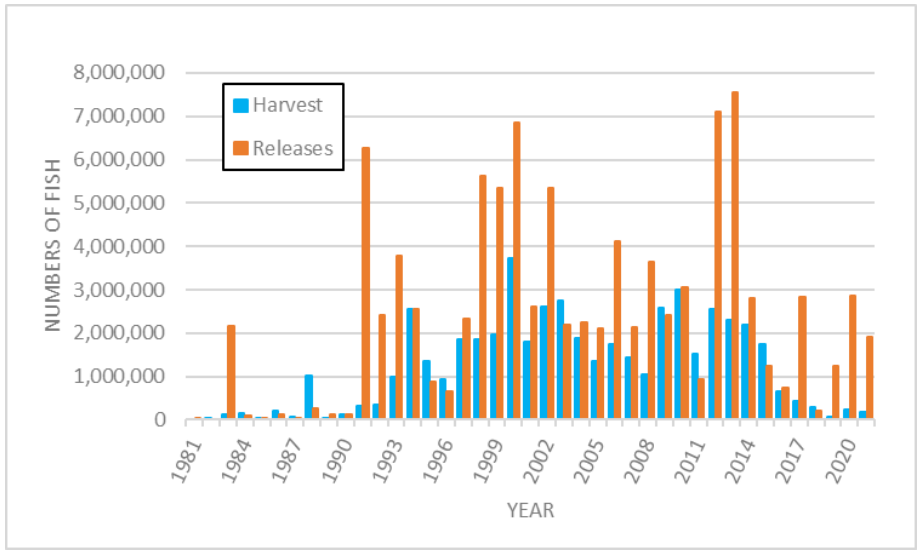
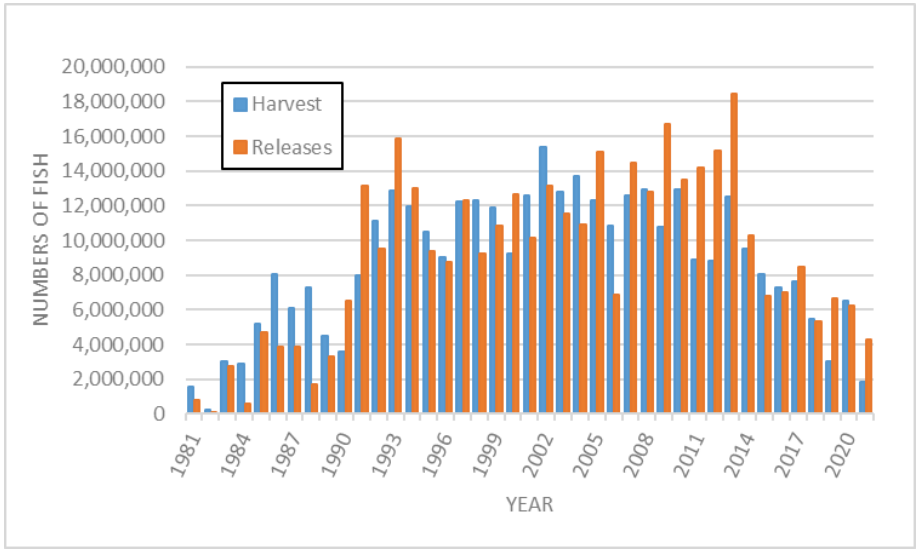


Figure 4. Virginia estimated recreational Atlantic croaker harvest and release, 1981-2021.[9]



Spot Management — The 2013 ASMFC Action Plan called for the evaluation of spot management triggers. As described above for Atlantic croaker, a similar TLA was approved for spot at the 2014 summer meeting of the ASMFC through an addendum to the Omnibus Amendment for Spanish Mackerel, Spot and Spotted Seatrout.[2,10] The TLA incorporates multiple data sources into a single metric and includes both population abundance and harvest data. If the threshold of 30% is triggered for two consecutive years, then state-specific management actions will be developed.[10] The ASMFC approved adjustments to the TLA methodology that were recommended by the Spot Plan Review Team, with the adoption of Addendum III in February 2020.[11] Additional indices were added and grouped by region (Mid-Atlantic and South-Atlantic), the triggering mechanism was changed to two out of the three most recent years, and coastwide harvest reductions will occur if the TLA triggers management action. The revised TLA was run in 2020 (data through 2019) and triggered management action for spot in the Mid-Atlantic region (in which the Chesapeake Bay resides). All non de minimis status states without a season or size limit in place were required to put in place a 50 fish bag limit and a 1% reduction to the previous 10 year average harvest. All of the Chesapeake Bay jurisdictions needed to enact both the recreational and commercial limits. All three jurisdictions instituted a 50 fish recreational bag limit. Maryland instituted a commercial season from April 10 through November 24, Virginia instituted an April 15 to December 8 season, and PRFC requested and was granted de minimis status.

Spot Stock Status — Overfishing and overfished status remain unknown. The first benchmark stock assessment was completed in 2016, peer reviewed in March 2017, and presented to the South Atlantic Board in May 2017. The assessment was not endorsed for management use by the independent peer review, but they agreed with the SAS that immediate management action was not required. The review panel recommended the continued use of the TLA until an improved assessment can be completed. The original spot TLA was updated and presented to the board in 2020 (data through 2019). The review team found that the harvest composite index (recreational and commercial harvest) in the Mid-Atlantic region was above the threshold in 2018 and 2019. The abundance composite index for the Mid-Atlantic region was above the 30% threshold in 2018 and 2019. Since both the harvest and adult abundance characteristics were above the 30% threshold in 2 of the past three years, management action was tripped on a coastwide level.

Two juvenile indices (JI) are calculated to evaluate recruitment of spot in Maryland's portion of Chesapeake Bay. A JI is calculated for spot from the Maryland Department of Natural Resources (MD DNR) Blue Crab Trawl Survey (BCS), and from the Maryland Estuarine Juvenile Finfish Survey (EJFS). These indices are highly variable. Chesapeake Bay juvenile indices were near their time series means in 2012, but declined steadily to a level near the time series low in 2015 for both surveys. The 2016 through 2018 values were higher than 2015 values, but remained well below average. The 2020 and 2021 values increased with both index values exceeding their time series means in both years.

Spot Fisheries — There is an order of magnitude difference in the commercial harvest of spot in Virginia and Maryland (Figures 5 & 6). However, commercial landings from both states indicate similar fluctuations across years. Landings were higher in the 1950s, decreased in the 1960s and 1970s, and rebounded in the 1990s. Maryland and Virginia commercial landings have remained relatively low for the past 7 years. Variability in spot landings is expected since it is a short-lived species. Year-class strength is impacted by annual environmental conditions. Recreational landings have been slightly less variable than commercial landings (Figures 7 & 8), likely due to recreational anglers' willingness to harvest smaller fish than those that are sold commercially. Both states had recreational harvests well below average in 2015 and 2016, but both states harvests have improved since.

Figure 5. Maryland commercial landings of spot: 1950-2021.[8]

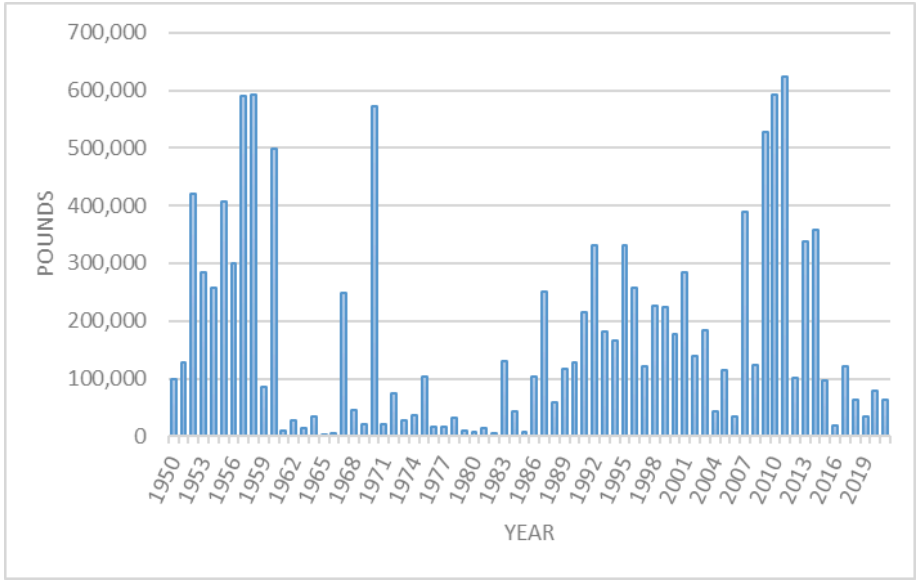


Figure 6. Virginia commercial landings of spot: 1950-2021.[8]

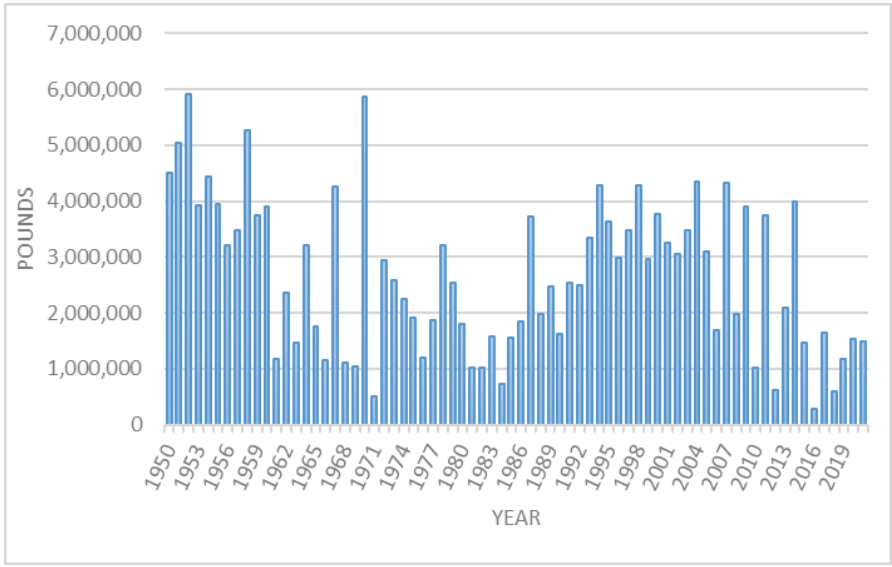


Figure 7. Maryland estimated recreational spot harvest and releases: 1983-2021.[9]

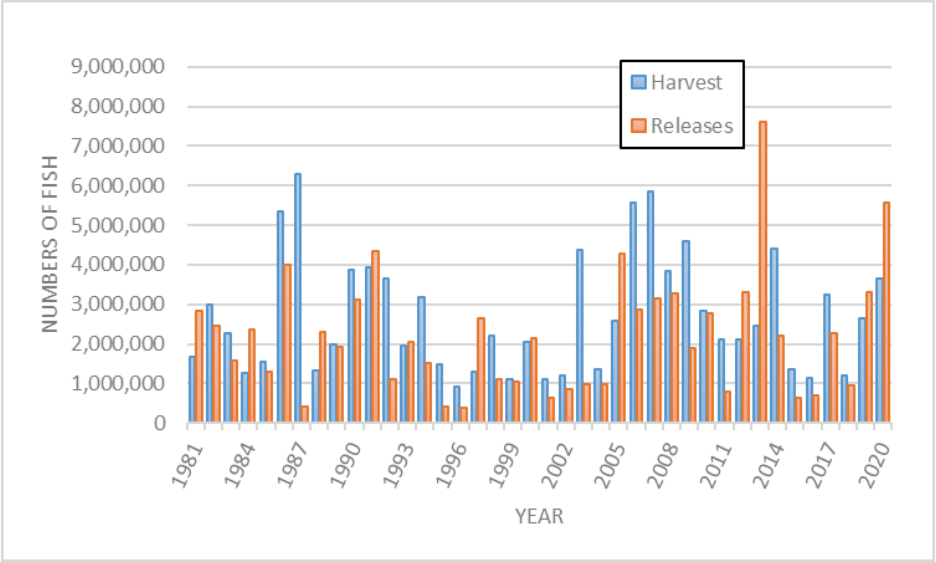
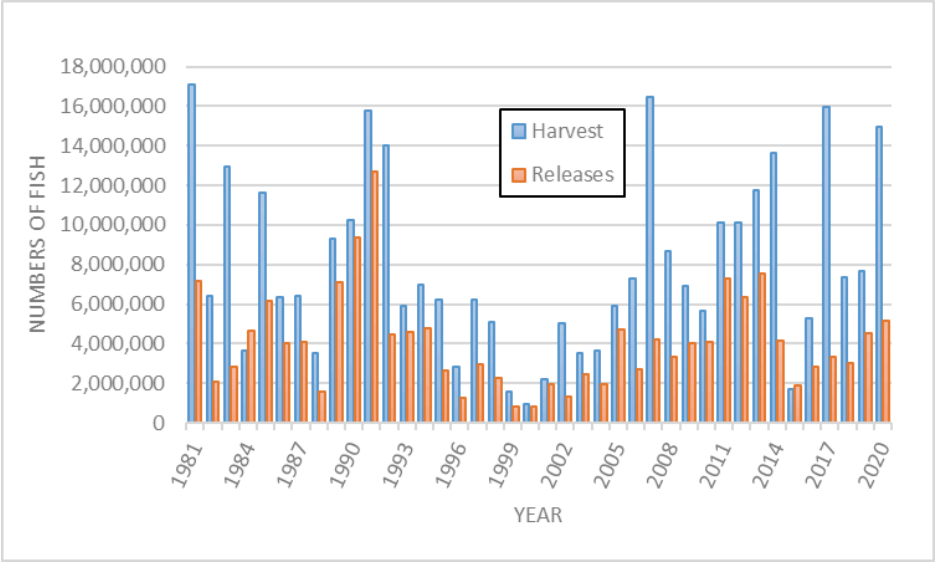


Figure 8. Virginia estimated recreational spot harvest and releases: 1983-2021.[9]



Management Measures

The refinements to the TLA adopted in 2020 include the addition of indices, splitting the TLA into Mid-Atlantic and South-Atlantic regions, refining independent indices to only include adult fish, and management measures that would be required if either TLA is triggered. The TLA triggered in 2020, requiring non de minimis coastal states to establish minimum regulations for both species if they did not have regulations in place for either species. Annual spot and Atlantic croaker compliance reports have been required by ASMFC since 2012 and 2006, respectively.[7,12] The 2022, evaluation with data through 2021, was limited by missing data due to the Covid-19 pandemic and a gear change by the ChesMMAP survey that necessitated calibration factors that were not done in time for the 2022 evaluation. The adult abundance indicators could not be updated for the Mid-Atlantic region, and were impacted by altered sampling protocol in the South Atlantic indices. The TC anticipates having the full ChesMMAP time series and a year of unaffected sampling available to make a full evaluation in 2023.

Issues/Concerns

Continued monitoring of the commercial and recreational harvest of both Atlantic croaker and spot is important in order to obtain data for conducting stock assessments and evaluating the status of the stocks. There is concern about the overall decreasing trend in commercial landings of both species along the coast. The ASMFC Atlantic Croaker and Spot Technical Committees will continue to monitor landings and make management recommendations if necessary. The use of circle hooks to reduce recreational discard mortality is encouraged. Both species are caught indirectly and together during other fishing activities; bycatch mortality is a continued concern. Small spot, for example, could account for as much as 80% of the shrimp trawl catch by weight, and 60% by number, depending on area.[7,13] States are encouraged to use bycatch reduction devices to reduce bycatch. As shrimp move farther north, fishermen in Chesapeake Bay jurisdictions are starting to inquire about shrimp trawling in Bay waters, and a limited Atlantic Ocean fishery has begun in Maryland. The use of traditional shrimping gear in the Bay would increase bycatch mortality of juveniles in a primary nursery area for both species.

Spot are used as live bait in both the commercial and recreational hook and line striped bass fisheries in the Chesapeake Bay. The implemented creel limits for spot could have some impact on these striped bass fisheries. The consequences of using small spot as bait are unknown. Spot used for the live bait fishery are harvested in fish pots or by hook and line. Both species are caught as bycatch in several commercial fisheries throughout the Chesapeake Bay, and there is the possibility of dead discards, and/or impact to other fisheries if dead discards are to be avoided.

References

[1] Atlantic States Marine Fisheries Commission. 2005. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Croaker. Fishery Management Report No. 44 of the Atlantic States Marine Fisheries Commission, Arlington, VA. 92p.

[2] Atlantic States Marine Fisheries Commission. 2011b. Addendum I to Amendment 1 to the Atlantic Croaker Fishery Management Plan, Arlington, VA 7p.

[3] Atlantic States Marine Fisheries Commission. 2014a. Addendum II to Amendment I to the Interstate Fisheries Management Plan for Atlantic Croaker, Arlington, VA 7p.

[4] Atlantic States Marine Fisheries Commission. 2020a. Addendum III to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Croaker. Revisions to Management using the Traffic Light Approach, Arlington, VA 14p.

[5] Atlantic States Marine Fisheries Commission. 2011a. Omnibus Amendment to the Interstate Fishery Management Plans for Spanish Mackerel, Spot, and Spotted Seatrout. Fishery Management Report of the Atlantic States Marine Fisheries Commission, Arlington VA 161p.

[6] Atlantic States Marine Fisheries Commission. 2017. Atlantic Croaker 2017 Stock Assessment Peer Review Report, Arlington, VA.

[7] Rickabaugh, H., Jr. 2022. Maryland Atlantic Croaker (*Micropogonias undulatus*) Compliance Report to the Atlantic States Marine Fisheries Commission – 2021. Maryland Department of Natural Resources Fishing and Boating Services. 4p.

[8] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, November 14, 2022.

[9] Personal communication from the National Marine Fisheries Service, Recreational Fisheries Statistics Division, Marine Recreational Information Program, November 14, 2022.

[10] Atlantic States Marine Fisheries Commission. 2014d. Addendum I to the Omnibus Amendment to the Interstate Fishery management Plans for Spanish Mackerel, Spot, and Spotted Seatrout, management of the Spot Fishery using the Traffic Light Approach, Arlington, VA. 7p.

[11] Atlantic States Marine Fisheries Commission. 2020b. Atlantic States Marine Fisheries Commission Addendum III to the Omnibus Amendment to the Interstate Fishery Management Plans for Spanish Mackerel, Spot, and Spotted Seatrout, Revisions to Spot Management using the Traffic Light Approach, Arlington, VA 14p.

[12] Rickabaugh, H., Jr. 2022. Maryland Spot (Leiostomus xanthurus) Compliance Report to the Atlantic States Marine Fisheries Commission – 2021. Maryland Department of Natural Resources Fisheries Service. 4p.

[13] Peuser, R (editor). 1996. Estimates of finfish bycatch in the south Atlantic shrimp fishery. Final Report of the SEAMAP-South Atlantic Committee: Shrimp Bycatch Work Group. Washington DC: Atlantic States Marine Fisheries Commission.

1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation			
Problem Area	Action	Date	Comments
Stock Status Annual abundance of Atlantic croaker and spot is highly variable from year-to-year. Little information is available on the causes of stock fluctuations.	1.1 CBP jurisdictions will continue to participate in scientific and technical meetings for managing Atlantic croaker and spot along the Atlantic coast, and in estuarine waters.	2005 2010 Continue 2017 2020	CBP jurisdictions will continue to monitor Atlantic croaker and spot stocks, and cooperate with the ASMFC to manage stocks through inter-jurisdictional management measures. BRPs were adopted for the coastal Atlantic croaker stock in 2005 and updated in 2010. Current estimates of F and SSB indicate that the Atlantic croaker stock was healthy and overfishing was not occurring (ASMFC 2010). The status of the coastal spot stock was undeterminable. No spot stock assessment had been completed. The ASMFC Spot PRT had been monitoring stock status through reports to the South Atlantic Management Board. Annual spot and Atlantic croaker compliance reports to ASMFC are required. A coast wide stock assessment for both species was initiated in 2015, and was peer reviewed in 2017. Stock status could not be defined, so it is currently considered unknown for both species. The TLA for both species was revised in 2020, and management action was triggered by the analysis. The TLAs will be used until a peer reviewed assessment is available for management of each species. Data limitations due to the Covid-19 pandemic did not allow for complete evaluation of the TLAs in 2021.
.	1.2.1 A) MD and the PRFC have a minimum size limit for Atlantic croaker**.** B) VA does not have a minimum size limit for Atlantic croaker.	Continue 1993 Continue	CBP jurisdictions will promote the increase in yield per recruit for the Atlantic Croaker and spot fisheries. MD and PRFC have a 9” minimum size limit and a 25 fish/person/day creel limit, and VA has a 50 fish creel limit for Atlantic croaker recreational fisheries. MD has an open commercial season from March 16 through December, with a 9” minimum size limit. VA has a commercial season of January 16 - December 31.
	1.2.2 CBP jurisdictions will evaluate the need to implement a minimum size limit for spot.	1992 2009 2011 2014 2020 Continue	No recommendations have been made for spot. There is some concern over declining juvenile abundance. The ASMFC omnibus amendment, approved in 2011, did not require additional management criteria. ASMFC revised the TLAs through Addenda (2020) for both species that triggered management action once run with data through 2019. Bay jurisdictions adopted a 50 fish recreational creel limit, and Maryland and VA established commercial seasons of April 10 through November 24 and April 15 to December 8, respectively. PRFC requested and was granted de minimis status.

Harvest of Small Atlantic Croaker and Spot Incidental bycatch and discard mortality of small Atlantic croaker and spot in non-directed fisheries is substantial, and has the potential to significantly impact Atlantic croaker and spot stocks.	2.1 A) Through the ASMFC, the jurisdictions will promote the development and use of trawl efficiency devices (TEDs) in the southern shrimp fishery, and promote the use bycatch reduction devices (BRDs) in the finfish trawl fishery. B) Virginia will continue its prohibition on trawling in state waters. Virginia will maintain its $2^{7}/_{8}$ inch minimum mesh size for gill nets C) Maryland will continue its 4-6 inch gill net restriction during June 15 through September 30, and implement a 3 inch minimum mesh size along the coast. D) PRFC will continue its prohibition on gill net fishing in the summer.	Continue 2004 Continue Continue	Commercial trawling is prohibited within the Chesapeake Bay in both MD and VA. The 2004 Atlantic Croaker Stock Assessment indicated that the coastal states were successful at reducing mortality on age 1 fish. The commercial & recreational catch-at-age data showed an increasing age distribution, with a few Atlantic croaker at age 12. The 2017 stock assessment analyses indicated that the shrimp bycatch estimates are a major component of total removals, and consist primarily of juvenile fish. ASMFC encourages states to use bycatch reduction devices (BRDs). The 2017 stock assessment also noted a reduction in size structure compared to the 2004 and 2010 assessments. MD currently allows attended gill nets with a stretched mesh size of 3 1/8 to 3 ½ inches, from January 1 through March 15, and 2 ½ to 3 ½ inches between March 16 and December 31 in the Chesapeake Bay and tributaries, with location restrictions during striped bass spawning seasons. The minimum stretched gill net mesh size in MD waters is 2 ½ inches. Virginia has a minimum gill net stretched mesh of 2 7/8”**.**
	2.1.2 CBP jurisdictions will investigate the magnitude of the bycatch problem and consider implementing bycatch restrictions for the non-directed fisheries in the Bay.	1992 Continue	CBP jurisdictions have evaluated the effectiveness of bycatch reduction panels in pound nets, and PRFC requires reduction panels for all pound nets. Some coastal states are using panels to reduce bycatch of small fish.
Research and Monitoring Needs There is a lack of stock assessment data for both Atlantic croaker and spot stocks in the Chesapeake Bay.	*3.1* VMRC stock assessment program will continue to analyze size and sex data from Atlantic croaker, and spot collected from the VA commercial fishery.	Continue 2010 Continue	The amount of data available for Atlantic croaker has increased since the 2003/2004 coastal stock assessment. The 2010 and 2017 ASMFC coastal stock benchmark assessment concluded that the coastal Atlantic croaker population is a single stock. Addendum 1 to the ASMFC FMP changed the management unit to a single stock and modified the BRPs. Stock assessment data for Atlantic croaker and spot is collected by the MD Estuarine Juvenile Finfish Survey, and VIMS Juvenile Abundance Surveys (formerly known as the VIMS Trawl Survey and the VIMS Juvenile Seine Survey), NEAMAP and ChesMMAP. Both Maryland and Virginia collect age, length, weight and sex data from commercially harvested spot and Atlantic croaker.
	3.2 A) MD and PRFC will encourage research to collect data	2008 Continue	An Atlantic Croaker Ageing Workshop was held in October 2008, and resulted in a standardized ageing procedure. High priority research & monitoring recommendations included: determining

	on Atlantic croaker and spot biology, especially estimates of population abundance, recruitment, and reproductive biology. B) VA will continue to fund its stock assessment research conducted by VIMS and ODU, specifically designed to provide the estimates of population abundance, recruitment, and reproductive biology.	2011 Continue Continue Continue	migratory patterns; collecting life history information; evaluating bycatch and discard practices, and examining reproductive strategies. Commercial catch-at-age data has contracted the last several years. Spot age structure has truncated with age 0 -1 fish dominating the catch, age 2 being rare, and age 3 to 6 years being absent from Maryland collections. Historically age 4-6 spot are not seen every year and when present, account for a small percentage of harvest, but age 3 spot were more common. Recommendations for spot in the 2011 omnibus amendment include: monitoring data and gear studies on discards from the shrimp, recreational and commercial fisheries; expanding sampling; assessing BRDs; continuing development of fishery-dependent and fishery-independent size and sex specific relative abundance estimates; evaluating juvenile indices to predict year class strength; improving catch and effort statistics, and developing stock assessment analyses such as a yield-per-recruit analysis and determining the inshore vs offshore components of the fishery. Commercial pound net sampling in Maryland's portion of the Chesapeake Bay was conducted from June 4 through mid September 20, 2021. Atlantic croaker mean length from the onboard pound net survey was 225 mm total length in 2021, and was the second lowest value of the 29 year time period. Ages ranged from 0 to 3 years old, with age 1 fish accounting for the majority of the catch. Spot mean length from the onboard was 186 mm, the eighth lowest value of the 29 year time period. No age two spot was encountered in 2021 and 99% of the sampled fish were age one. The fishery has been almost entirely supported by age 0 and 1 spot for the past few years. Atlantic croaker juvenile abundance from the Maryland Chesapeake Bay Blue Crab Trawl Survey was high in 2012, declined through 2015 to the 2nd lowest value of the 33 year time period, remained below the series mean from 2016 - 2018, but increased to just above the time series mean in 2020 and fell to just below the timeseries mean in 2021. The spot Chesapeake Bay juvenile trawl index increased in 2016 -2018 after declining from 2013 to 2015, but remained well below the time period mean. The 2020 and 2021 values increased to just above the 33 year time period mean.
Habitat and Water Quality Issues Habitat alteration and water quality impact the distribution of finfish species in the Chesapeake Bay	4.1CBP jurisdictions will continue to set specific objectives for water quality goals, and review management programs established under the 1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement call for: A) Developing habitat requirements and water quality goals for various finfish species.	2000	Water quality and living resource commitments were updated and renewed in the Chesapeake Bay 2000 Agreement. These activities include the discharge of toxic pollutants or excessive nutrients into the Chesapeake Bay and its tributaries, interruption or changes in water discharge patterns, deposition of solid waste, sewage sludge or industrial waste into the Bay (which may lead to anoxic conditions), rapid coastal development, unregulated agricultural practices, net coastal wetland loss, or the dredging of contaminated subaqueous soils. Based on the most recent available data, scientists project that 58% of the pollution reduction efforts needed to achieve the Bay restoration goals have been implemented since 1985. Excess nitrogen, phosphorus and sediment are the major pollutants. The greatest challenge to achieving restoration is population growth and development, which destroys forests, wetlands and other natural areas.

	B) Developing and adopting basinwide nutrient reduction strategies. C) Developing and Adopting basinwide plans for the reduction and control of toxic substances. D) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point source and non-point sources. E) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system. F) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation (SAV). G) Managing population growth to minimize adverse impacts to the Bay environment	2009 2014 Continue 2016-2017 2018-2019	Habitat and water quality objectives and actions were delineated in the President's Executive Order and provide more current strategies for managing resources in the Chesapeake Bay. Estuaries are designated as Habitat Areas of Particular Concern (HAPC) for spot. The CBP developed a new Watershed Agreement in 2014, with outcomes and strategies that address sustainable fisheries, vital habitats, water quality, toxic contaminants, healthy watersheds, stewardship, land conservation, public access, environmental literacy, and climate resiliency. For more information see: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf Of particular interest for Atlantic croaker and spot is the evaluation of forage in the Chesapeake Bay as part of the sustainable fisheries outcomes. A two-year work plan (2016-2017) was developed to address forage in the Bay, and a STAC workshop was held in 2014. Both small spot and Atlantic croaker were important forage for several of the key predator species. For more details, go to the workshop report at http://www.chesapeake.org/pubs/346_Ihde2015.pdf. The forage work plan was evaluated and updated during 2017/2018 and can be found at https://www.chesapeakebay.net/files/documents/2018-2019_Forage_Fish_Outcome_Workplan_Final.pdf

Acronyms

ASMFC – Atlantic States Marine Fisheries Commission
ODU – Old Dominion University
BRDs – Bycatch Reduction Devices
PRFC – Potomac River Fisheries Commission
BRPs – Biological Reference Points
PRT – Plan Review Team
CHESFIMS – Chesapeake Bay Fishery Independent Multispecies Fisheries Survey
SEAMAP – Southeast Area Monitoring and Assessment Program
ChesMMAP – Chesapeake Bay Multispecies Monitoring and Assessment Program
SAS – Stock Assessment Sub-Committee
CBP – Chesapeake Bay Program
NMFS – National Marine Fisheries Service
SSB – Spawning Stock Biomass
F – Fishing mortality
STAC – Scientific and Technical Advisory Committee
FMP – Fishery Management Plan
TLA – Traffic Light Approach
NEAMAP – Northeast Area Monitoring and Assessment Program
VIMS – Virginia Institute of Marine Science

2021 Maryland FMP Report (December 2022)
Section 4. Atlantic Menhaden (*Brevoortia tyrannus*)

The Atlantic States Marine Fisheries Commission's (ASMFC) Atlantic Menhaden Management Board (Board) approved the results of the 2019 Atlantic menhaden benchmark stock assessment for management use in February 2020. The Board also approved the use of ecosystem based reference points (ERPs; August 2020), using the ERP model that was peer reviewed during the benchmark stock assessment. The stock was not found to be overfished, and overfishing was not occurring based on the results of the 2019 assessment and ERPs set by the Board. However, based on model projections, overfishing was likely to occur by 2022 at the 2020 total allowable catch (TAC) level. The coastwide TAC for 2021 and 2022 was set at 194,400 metric tons (mt) or 428,578,638 pounds (lbs), a 10% reduction from the 2020 value. An assessment update was completed in 2022 and will be presented to the Board in November 2022. The Board will set the TAC for 2023 and potentially subsequent years based on the results of the assessment. The Board also initiated an Addendum to address commercial allocation, to try and better align allocation to current fishery performance, and reduce reliance on state to state transfers, and is expected to take final action on this Addendum in November 2022.

ASMFC Fishery Management

An Interstate Atlantic Menhaden FMP was first developed by the ASMFC in 1981. The plan was revised in 1992, replaced by Amendment 1 in 2001 and five addenda (2004, 2005, 2006, 2009, 2011), then replaced again by Amendment 2 in 2012 and two addenda (2013, 2016). The stock is currently managed under Amendment 3 (2017).[1] Amendment 3 reallocated commercial fishery quotas, maintained the bycatch allowances established in Addendum 1 of Amendment 2, and continued the use of single species reference points while ERP model development continues. Each jurisdiction was given a base, calculated as 0.5% of the TAC, with the remaining TAC divided according to the average 2009-2011 landings by jurisdiction. The Board maintained the 2020 TAC at 216,000 mt (476,198,486 lbs), and reduced the TAC for 2021 and 2022 to 194,400 mt (428,578,638 lbs).

The stock assessment update and revision in 2010 resulted in Addendum V to Amendment 1 (2011), with new biological reference points. The goal of Addendum V was to increase abundance, to increase spawning stock biomass, and to increase menhaden availability as forage. The 2011 threshold and target for biomass was based on a maximum spawning potential (MSP) of 15% and 30%, respectively. Amendment 2 was developed to reduce fishing mortality, to reduce the risk of recruitment failure, to reduce the impacts to other species that are dependent on menhaden as prey, and to minimize adverse effects on the fishery. The ASMFC Addendum I (2016) added flexibility to the bycatch provision by allowing two qualifying commercial fishermen, utilizing stationary multispecies gear to harvest two bycatch limits, when working from the same vessel on the same day. This provision was requested by the Maryland Department of Natural Resources (MD DNR) and the Potomac River Fisheries Commission (PRFC) to accommodate the standard working practices of Chesapeake Bay pound net fishermen. Addendum II is currently under development and considers revising commercial allocation to better align current fishery performance to allocation structure and to reduce latent quota and reliance on state to state transfers.

Stock Status

The coastal menhaden stock has been assessed several times since 1999. Biological reference points (BRPs) were established in 2001, and updated in 2004. A benchmark assessment was peer reviewed in 2010, and included two new components: a factor for aging error and natural mortality rates that varied with age and time. The assessment was updated in 2012[2] with data from 2009 through 2011, and indicated that fishing mortality rates were above the overfishing reference point, and overfishing was occurring. Results of the 2012 update were inconclusive to determine if the stock was overfished. A 2014 benchmark assessment addressed several issues from the previous assessments. The age at maturity was corrected, and alternative selectivity patterns in the fishery were utilized, and resulted in a higher estimated proportion of age 1, 2, and 3-year old fish in the population. Most significantly, the assessment used nine new fishery-independent indices, rather than the single Chesapeake Bay pound net index that was used in the 2010 assessment. The 2014 benchmark assessment[3], and a 2017 update of that assessment, concluded that the Atlantic menhaden resource was not overfished.

The most recent benchmark stock assessment was conducted in 2019[4] and consisted of a traditional single species model and an ecological reference point (ERP) model, which were to be used in conjunction with one another to determine stock status. The Board accepted the results of the assessments for management use in 2020. The 2019 assessment determined that the menhaden stock is not overfished, and overfishing is not occurring. Total instantaneous fishing mortality (F) was estimated at 0.16, below the ERP threshold of 0.57 and below the ERP target of 0.19. The ERP model takes into account the role of menhaden as prey for several key predatory species, as well as the abundance of Atlantic herring, another key prey of those species, and results in lower target and threshold values than the single species model. Details of the 2019 assessment can be found on the ASMFC webpage (www.asmfc.org) under Atlantic Menhaden fisheries management. An update of the 2019 assessment will be completed in 2022.

Coastal recruitment indices have been generally low since the 1980s. In Maryland, juvenile menhaden are sampled annually through the Estuarine Juvenile Finfish Survey. The index of juvenile menhaden has been below average since 1992, but has been higher in recent years, with the 2021 value being the second highest since 1992 (Figure 1).[5] The development of new management actions and reduced harvest could contribute to higher recruitment, but environmental conditions seem to be a major factor driving recruitment.

Management Measures

The coastal overfishing designation in 2013 resulted in management measures to reduce harvest by 20%, compared to the 2009 to 2011 average harvest. Based on the 2010 BRPs, a total allowable catch (TAC) of 170,800 mt (376,549,574 lbs) was calculated for the Atlantic states for 2013. The coastal TAC was allocated state-by-state based on average state landings (2009-2011). Maryland's 2014 quota was 1.37% of the TAC or 2,320 mt (5,116,874 lbs), Virginia's was 85.32% of the TAC (318,066,790 lbs), and PRFC's was 0.62% of the TAC (2,334,607 lbs). The TAC was increased by the Board twice prior to Amendment 3, but the percent allocation of the TAC by state did not change, leading to increased allocation for each jurisdiction. The increased TAC and allocation changes of Amendment 3 resulted in more significant changes to the jurisdictional quotas for 2018 through 2020. Maryland, Virginia, and PRFC quota percentages, and corresponding pounds allotted, were 1.89% (8,901,558 lbs), 78.66% (370,846,528) lbs, and 1.07% (5,060,296 lbs), respectively. The Board reduced the TAC by 10% for 2021 and 2022 in late 2020, after receiving requested projection analysis from the Atlantic Menhaden Technical Committee using the new ERPs. The Maryland, Virginia, and PRFC quotas for 2021 and 2022 are 8,0737,057 lbs, 335,206,390 lbs, and 4,564,863 lbs, respectively.

The coastwide commercial menhaden fishery is composed of two different components: the reduction fishery (fish caught by purse seines and processed for fish oil/fish meal), and the bait fishery (fish for other commercial and recreational fisheries such as the blue crab fishery). Purse seining, the predominant gear type for harvesting menhaden, is not allowed in the Maryland portion of the Chesapeake Bay. However, menhaden are harvested from pound nets for the bait fishery. Virginia allows purse seining in the Lower Bay. Omega Protein has a menhaden reduction plant in Reedville, Virginia, which is the only active menhaden reduction factory on the Atlantic coast. The ASMFC Addendum II to Amendment I (2006) established a harvest cap (109,020 mt or 240,347,958 lbs) for the reduction of fishery in the Chesapeake Bay. With the adoption of ASMFC Amendment 2, there was a 20% reduction in the harvest cap based on average landings from 2001-2005 to 87,216 mt (192,278,367 lbs). The Chesapeake Bay reduction fishery harvest cap was reduced further in Amendment 3 to 51,000 mt (112,435,754 lbs). Reduction fishery landings in 2019 exceeded the cap due in part to Virginia not incorporating the cap reduction into regulation. Virginia was found out of compliance with the FMP. Regulatory oversight of Atlantic menhaden in Virginia was transferred from the legislature to the Marine Resources Commission, which in turn instituted the lowered Chesapeake Bay harvest cap. The correction of the regulations, coupled with a reduction of the 2020 cap equal to the overage in 2019, brought Virginia back into compliance with the FMP.

The Fishery

The 2021 Maryland menhaden harvest was 2,888,498 lbs (does not include PRFC landings), and was below the 2021 quota. The bait fishery in Maryland is primarily a pound net fishery. This single gear type accounted for 98% of the 2021 total reported harvest. Virginia's total Atlantic menhaden harvest for 2021 was 301,349,508 lbs.[6] Figure 3 includes some PRFC landings and includes the reduction fishery and the bait fishery from both the Chesapeake Bay and Atlantic Ocean. None of the Bay jurisdictions have exceeded their open fishery quota since the quotas were enacted in 2013. Fishery performance may have been impacted in 2020 by restrictions put in place due to the Covid-19 pandemic. As an example, Virginia's reduction fishery did not operate for several weeks due to a mandatory plant closure.

In 2021, biological monitoring from the Maryland pound net (bait) fishery indicated that the majority of harvested menhaden were age 1, with age 2 accounting for the second highest proportion of the catch. Menhaden sampled from the Choptank River fishery independent gill net survey were predominantly age 2, with a higher proportion of age 3 plus fish, indicating the gill net survey selected slightly older fish than the commercial pound net fishery. Maryland DNR will continue to collect biological data on fish sampled from commercial pound nets, and will continue the Choptank River gillnet survey.

Issues/Concerns

Significant changes in management were put in place in Maryland during June 2013 to meet the state-specific quotas set forth by ASMFC compliance requirements. The commercial fishery continues to be managed under a coastal TAC, with subsequent state quotas. All watermen harvesting menhaden from pound nets are required to obtain a bycatch permit, and to report their catch on a daily basis. Once the fishery is closed, a bycatch limit of 6,000 lbs per day is allowed for permit holders (12,000 lbs per vessel, if two fishermen with bycatch permits are working together). Non-permit holders are restricted to a bycatch limit of 1,500 lbs.

Menhaden have a unique role in the Chesapeake Bay ecosystem, as both a primary filter-feeder and an important forage species for top predators (striped bass, bluefish, osprey, etc.). The change to using ERPs should benefit the Atlantic menhaden stock and the predators that rely on them. Menhaden support a major commercial fishery, which is the Bay's largest fishery by weight. Consequently, they are an economically important species.

Two ways to improve the menhaden stock assessments (and recommended by ASMFC), are the development of a coastwise fishery-independent survey to assess adult abundance at age and better estimates of natural mortality by age class.

Figure 1. Geometric mean catch per haul of Atlantic menhaden juveniles in the Maryland portion of the Chesapeake Bay, 1959-2021.[5]

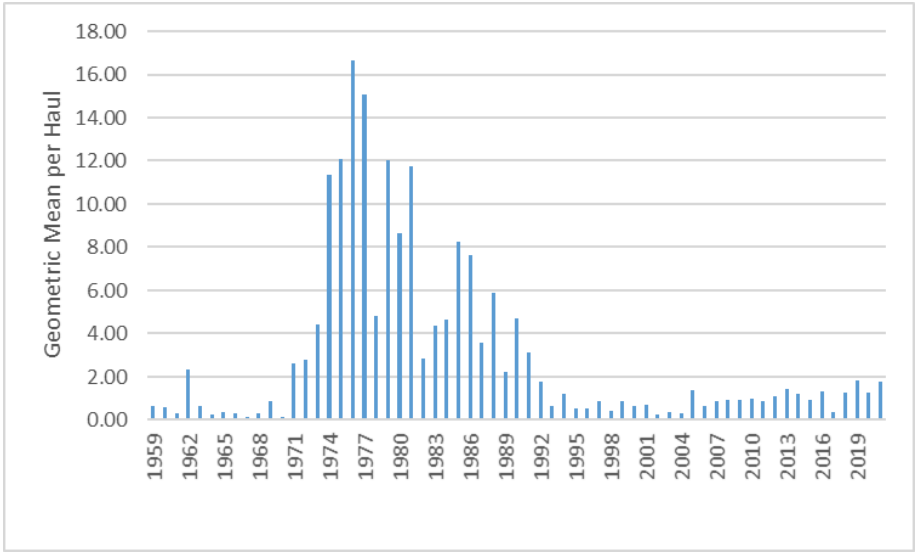


Figure 2. Maryland Atlantic menhaden commercial landings from the NMFS database (includes PRFC landings sold in Maryland), 1981-2021.[6]
Values for 1995 and 1996 were missing from NMFS so Maryland data was substituted (does not include PRFC).

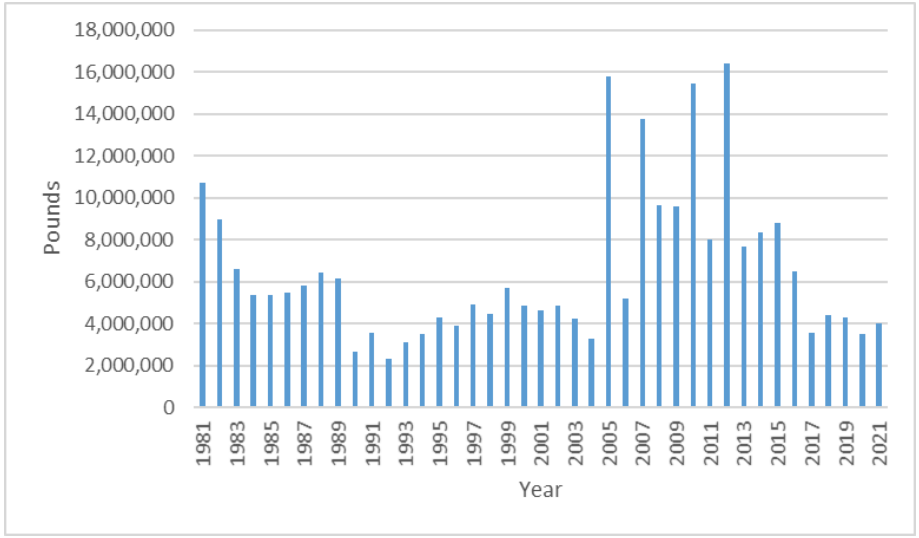
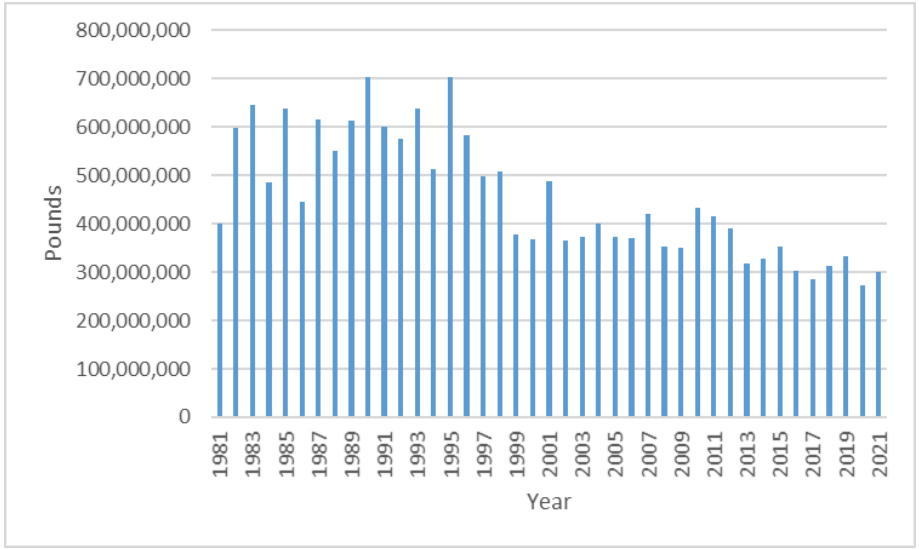


Figure 3. Virginia Atlantic menhaden commercial landings from the NMFS database (includes PRFC landings sold in Virginia), 1981-2021.[6]



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2021 Maryland FMP Report (December 2022)
Section 5. Black Drum (*Pogonias cromis*)

The Atlantic States Marine Fisheries Commission (ASMFC) approved Addendum I to the Interstate Fishery Management Plan for Black Drum (May 2018), allowing Maryland to reopen a limited commercial fishery in its portion of the Chesapeake Bay. Maryland reopened the Chesapeake Bay commercial fishery on February 25, 2019 with a 28 inch minimum size limit and a 10 fish per vessel per day catch limit. In its first three years, the reopened fishery landed between 681 and 6,838 pounds (lbs) of black drum per year, well below the 10 year average of 17,757 lbs for the fishery prior to the 1998 closure. ASMFC initiated a benchmark stock assessment in 2021, the draft assessment was completed in October of 2022, and the peer review is scheduled for late 2022.

Fishery Management Plans (FMPs)

The Chesapeake Bay Black Drum Fishery Management Plan (CBBD FMP) was adopted in 1993 to address concerns about potential overfishing. The objectives of the plan include: 1) promoting coastwide coordination where possible; 2) promoting the protection of the resource through conservation goals and allocation; 3) maintaining the spawning stock to minimize recruitment failure; 4) promoting the collection of data; 5) promoting fair allocation, and 6) promoting water quality and habitat protection. Maryland Department of Natural Resources Fishing and Boating Services (FABS) conducted a review of the 1993 CBBD FMP in 2010, and determined that the plan is still an appropriate framework for managing the black drum stock.

The ASMFC Interstate Fishery Management Plan for Black Drum[1] (ASMFC FMP) (June 2013) was initiated because of increased recreational and commercial harvest, inconsistent coastwide regulations, unknown condition of the stock, and concerns about harvesting immature and breeding black drum. All states are required to maintain their current level of restrictions on the black drum fishery, and establish a maximum possession limit (January 1, 2014) and a minimum size limit of 14 inches (January 1, 2016). The Chesapeake Bay jurisdictions have implemented a more conservative 16-inch minimum since the mid-1990s**.** Addendum I[2] was approved by the board in May 2018. It allows Maryland to establish a 10 fish or less daily commercial harvest limit, with a minimum size of 28 inches total length or larger.

Stock Status

The first coastwide benchmark stock assessment for black drum was conducted in 2014, and approved for management use in 2015.[3] The 2015 benchmark stock assessment used a Depletion Based – Stock Reduction Analysis and determined that the stock is not overfished and not experiencing overfishing.[3] The assessment indicated biomass was slowly decreasing but remained well above the level needed to sustain maximum sustainable yield. Tagging data, life history data, and genetic results, using nuclear microsatellite markers indicate black drum are from a single U.S. Atlantic coast stock. The next benchmark stock assessment was initiated in 2021 and is tentatively scheduled for peer review in December 2022. The ASMFC approved the 2020 Black Drum FMP Review[5] (data through 2019) in February 2021. Estimated total landings were 4.7 million lbs. The recreational catch estimate methodology changed in 2018, increasing recreational harvest estimates throughout the time series. This makes comparing current landings to the reference points derived in the 2015 stock assessment inappropriate.

Current Management Measures

Maryland closed its Chesapeake Bay commercial black drum fishery in 1999 but retained a limited Atlantic coastal commercial fishery with a 1,500 lbs annual limit and 16 inch size limit. The ASMFC's adoption of Amendment I allowed the reopening of a limited Maryland Chesapeake Bay commercial fishery on February 25, 2019, with a 28 inch minimum size limit and a 10 fish per vessel per day catch limit. All other commercial and recreational regulations remained unchanged. Virginia manages its commercial fishery through limited entry and a total allowable catch of 120,000 lbs with a 16 inch size limit. Both states require mandatory commercial harvest reporting. Virginia established a special management zone in the southeast portion of the Chesapeake Bay for black drum, further restricting some commercial gear. The Potomac River Fisheries Commission also has a 16 inch minimum size limit, and allows commercial fishermen 1 fish per licensee per day. The harvest of black drum is primarily from the recreational fishery. Both states and the Potomac River allow a recreational harvest of 1 fish over 16 inches.

Maryland monitors commercial pound nets in Maryland's portion of the Chesapeake Bay, and black drum are occasionally encountered (zero to 44 per year); 12 were encountered in 2020\2021. Over 29 years of monitoring, fish length has ranged from 5 to 52 inches. The fishery independent seine survey conducted in the Maryland Coastal Bays has captured low numbers of juvenile black drum throughout most of the 33-year time series (zero to 77 fish per year), indicating some use of the area as nursery habitat.

The Fisheries

Virginia has a spring gill net fishery that targets adult black drum. The remaining commercial harvest is primarily from the bycatch of fisheries targeting other species (Figure 1). Preliminary 2021 commercial harvest from Maryland was 821 lbs and

from Virginia was 57,373 lbs. Recreational anglers occasionally target black drum in the spring, but harvest is sporadic especially in Maryland (Figure 2), with high percent standard error for most values indicating imprecise estimates.

Issues/Concerns

Requests from commercial watermen to consider reopening the commercial harvest of black drum in the Chesapeake Bay occurred over several years. Addendum 1 allowed the fishery to reopen in 2019. The 16 inch minimum recreational and Atlantic commercial size limit does not protect all immature black drum. Females reach 100% maturity at 6 years of age and a length of 28 inches.

The ASMFC released a fish habitat report that includes a section on black drum habitat by life stage, areas of particular concern, and threats. Some of the habitat recommendations for black drum of particular importance to Maryland include minimizing wetland loss, promoting living shorelines, evaluating the role of submerged aquatic vegetation (SAV) and other submerged structures, and continuing to support habitat restoration projects that enhance or restore bottom habitat.[5] The full report can be found at https://asmfc.org/wp-content/uploads/2024/12/HMS14_AtlanticSciaenidHabitats_Winter2017.pdf

Figure 1. Reported Maryland and Virginia commercial harvest of black drum in pounds, 1981 - 2021.[6] PRFC landings are divided between the states by NMFS based on the state in which the fish are sold.

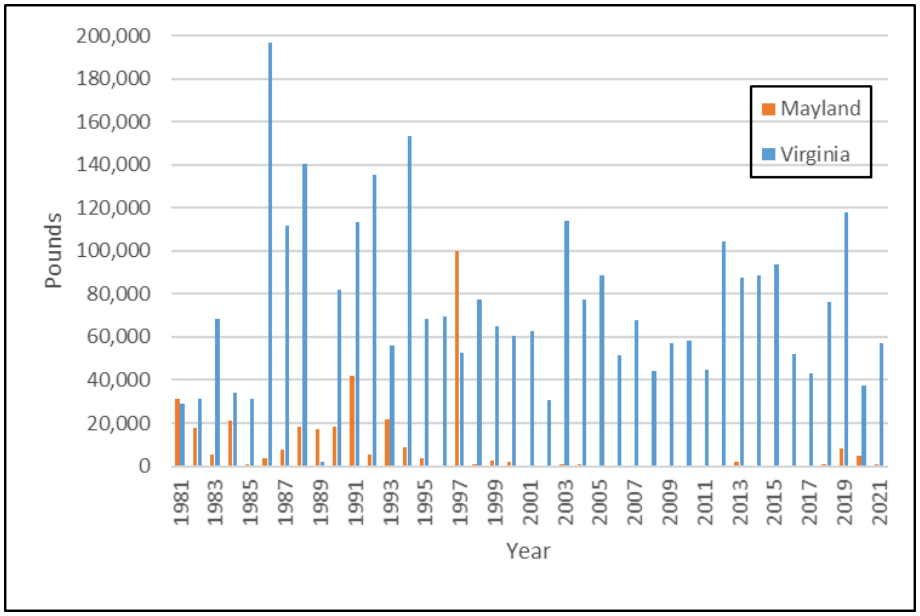
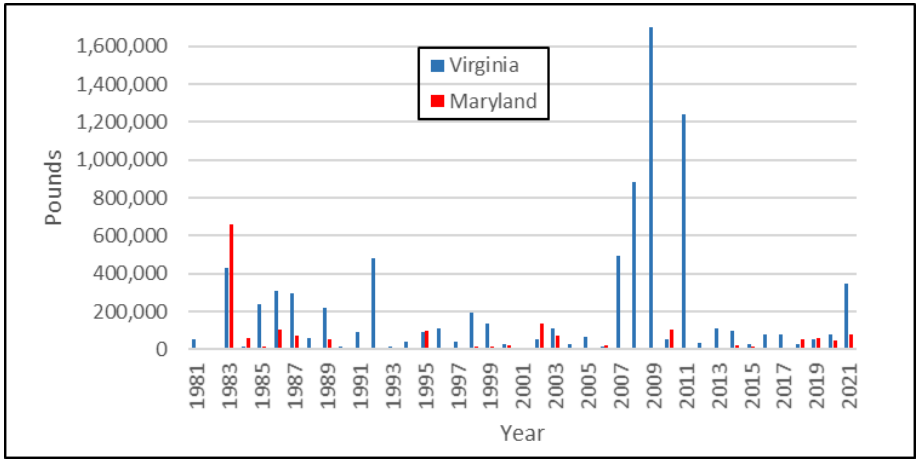


Figure 2. Recreational harvest estimate (MRIP) of black drum in pounds from inland waters for Maryland and Virginia, 1981 - 2021.[7]



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[1] Atlantic States Marine Fisheries Commission, June 2013. Interstate Fishery Management Plan for Black Drum, Arlington, VA. 72pp.

[2] Atlantic States Marine Fisheries Commission, May 2018. Addendum I to the Black Drum Fisheries Management Plan, Arlington, VA. 4pp.

[3] Atlantic States Marine Fisheries Commission, February 2015. Black Drum Stock Assessment and Peer Review Reports, Arlington, VA. 351pp.

[4] Atlantic States Marine Fisheries Commission, February 2021.Atlantic States Marine Fisheries Commission Review of the Interstate Fisheries Management Plan for Black Drum *(Pogonias cromis*); 2019 Fishing Year. Arlington, VA. 13pp.

[5] Atlantic Sciaenid Habitats: A Review of Utilization, Threats, and Recommendations for Conservation, Management, and Research. 2017. Atlantic States Marine Fisheries Commission Habitat Management Series No. 14, Arlington, VA.

[6] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. October 18, 2022.

[7] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. October 18, 2022.

1993 Chesapeake Bay Program Black Drum Implementation			
Problem	**Action**	**Date**	**Comments**
1. Status of Stock	1. Virginia (VA) will continue tagging black drum to determine coastal movements of the Chesapeake Bay Stock, fund research to determine age, fecundity, and spawning periodicity, and sample the commercial and recreational catch to determine length, weight, and sex. Maryland (MD) will continue to support the Old Dominion University (ODU) drum tagging study.	Continue 1998-1999 2015 2018	VA's tagging program was opportunistic. Between 2007 and 2012 over 1300 black drum were tagged from Virginia waters. The ODU tagging study is complete. ODU has an ongoing otolith aging study for black drum**.** Forty-eight black drum were collected in 2007 with an average age of 33.8 years (range 0-64 years MD conducted an adult tagging program from commercial pound nets in 1998 and 1999**.** ASMFC conducted a peer reviewed coastwide stock assessment in 2014/2015.[2] The assessment determined black drum were not overfished and overfishing was not occurring. Priority research recommendations include increased age and length samples from commercial and recreational fisheries, better bycatch information including lengths of discarded fish, continued fishery independent surveys and the development of an adult fishery independent survey. Revised MRIP recreational harvest estimates are much higher than those used in the ASMFC assessment, making comparison to the target fishing level inappropriate.
2. Fishing Mortality	2a VA will limit entry into the commercial black drum fishery and continue to require commercial black drum fisherman and buyers to obtain a permit and report weekly. VA will continue a 16-inch minimum size limit, 120,000-pound commercial quota, a 1 fish/person/day recreational creel limit and continue monitoring commercial and recreational landings.	1992 1994 Continue	Fully implemented. VA will emphasize the need for timely reporting.
	2b MD will adopt a 16-inch minimum size limit and a 1 fish/person/day recreational creel limit	1994 Continue	COMAR 08.02.05.15 The minimum size limit (16") with a creel limit of 1 fish/person/day and a maximum of 6 fish/boat.
	2c Potomac River Fisheries Commission (PFRC) will consider similar size and bag limits once VA and MD regulations are established.	1994 Continue	PFRC adopted a 16-inch minimum size limit and 1 fish/person/day creel limit for recreational and commercial fisheries.
	2d MD and PFRC will assess the need for commercial black drum harvest restrictions as data becomes available.	1994 1998 Continue	MD- Beginning in 1998, the commercial catch of black drum from the coastal bays and tributaries, and the Chesapeake Bay and its tidal tributaries is prohibited except for scientific investigation. Total allowable landings from the Atlantic Ocean are 1,500 lbs.

		2019 Continue	With the approval of ASMFC Amendment 1, Maryland reopened a limited Chesapeake Bay commercial fishery in 2019, with a 28 inch minimum size limit and 10 fish per day catch limit.
3. Gear Conflicts	3. VA has established a Special Black Drum Management Zone, for "high use" areas such as the Cabbage Patch and Latimer Shoals. During May 1 through June 7, no gill net or trot line may be in the established zone from 7:00 AM to 8:30 PM.	1992 Continue	Established to address commercial and recreational area and time conflicts.
4. Habitat Issues	4.1-7 Bay jurisdictions will continue to set water quality goals and review management programs under the 1987 Chesapeake Bay Agreement.	Continue	The CBP completed a Chesapeake Bay Watershed Agreement in 2014, which set new goals and outcomes for restoration and protection of the Chesapeake Bay and its watershed. A copy of the 2014 agreement can be found on the CBP website at http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf The agreement has fish habitat, blue crab, oyster, SAV, and water quality outcomes that when reached, will enhance habitat and prey availability for juvenile and adult black drum.

Acronyms

ASMFC – Atlantic States Marine Fisheries Commission
CBP – Chesapeake Bay Program
COMAR – Code of Maryland Regulations
MRIP – Marine Recreational Information Program
NMFS – National Marine Fisheries Service
ODU – Old Dominion University
PRFC – Potomac River Fisheries Commission
SAV – Submerged Aquatic Vegetation

2021 Maryland FMP Report (December 2022)
Section 6. Black Sea Bass (*Centropristis striata*)

The Mid-Atlantic Fishery Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission's (ASMFC) Summer Flounder, Scup, and Black Sea Bass Board (Board) passed Addendum XXXIII in February 2021 changing the state commercial black sea bass harvest allocations. The council and board also approved changes to the commercial and recreational allocations of black sea bass during a joint meeting in Annapolis, Maryland in December of 2021. These changes are intended to better reflect the current understanding of the historic and recent proportions of catch and landings from the commercial and recreational sectors. The new harvest allocations are 45% commercial and 55% recreational and will take effect in January of 2023.

Black sea bass population dynamics and tagging studies indicate they have regional rather than coastwide migrations. Adult fish prefer habitats near structures such as reefs and shipwrecks, and exhibit seasonal site fidelity (the tendency to return to a previously occupied location). In the mid-Atlantic, black sea bass display site fidelity in the summer and migrate offshore to areas south of New Jersey in the winter. In contrast, adults in the South Atlantic do not migrate as far during the winter. As a result, regional management has been implemented and incorporated into the coastal management framework and is evaluated on a yearly basis.

Fishery Management Plans (FMPs)

The Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan (BSB FMP) was adopted in 1996. At that time, the black sea bass stock was overfished. The BSB FMP was developed to reduce fishing mortality particularly on juvenile black sea bass. The Chesapeake Bay and Coastal Bays provide nursery areas for juvenile black sea bass which utilize reef structures and submerged aquatic vegetation (SAV). Protecting these two habitats is part of the Chesapeake Bay Program's habitat goals.

Black sea bass were incorporated as one component of the ASMFC and MAFMC's joint management framework for summer flounder and scup in 1996, with a Black Sea Bass Fishery Management Plan (ASMFC/MAFMC BSB FMP). The coastal ASMFC/MAFMC FMP implemented permit requirements for charter boats, commercial fishermen, and seafood dealers; specifications for fishing gear, and criteria to designate special management zones around artificial reefs. A progressive implementation schedule was instituted to increase minimum size, reduce landings, modify gear, and introduce a commercial quota system. Several addenda (ASMFC), frameworks (MAFMC), and amendments have been implemented to modify the overfishing mortality threshold and target exploitation rates and quota management.

Addenda IV (2001), VI (2002), and XVI (2005) improved upon the timeliness of developing and implementing management requirements. Framework 1 (2001) established a research set-aside quota. Amendment 13 (2002, 2003) was developed to reduce fishing mortality, improve yield, align and minimize jurisdictional regulations, and revise the commercial quota system. Addendum XII (2004) instituted state-by-state quota shares for the commercial fishery; Maryland's share was 11%. Addendum XIII (2004) and Framework 5 (2004) established that a commercial quota can be specified for up to three years at a time. Addendum XIX (2007) continued state-by-state commercial quota management which began in 2003. Framework 7 (2007) improved the efficiency of implementing management actions as stock status changed. Amendment 16 (2007) standardized requirements for bycatch reporting. Addendum XX (2009) streamlined the procedures for commercial quota transfer among states. Addenda XXI (2011), XXIII (2013), and XXV (2014) provided flexibility for regional management measures**.** Addenda XXI (2011), XXIII (2013), and XXV (2014) provided flexibility for regional management measures. Addenda XXVII (2016) through XXXII (2018) continued the use of adaptive regional management measures for the recreational fishery through 2021. Addendum XXXIII passed in February 2021 changed the state commercial harvest allocations. In December 2021 the commercial/recreational split was amended. The new allocations take effect in 2023.

Stock Status

The 2019 operational assessment included data through 2018 and used the Marine Recreational Information Program (MRIP) data as part of the analysis.[1] The new assessment determined that black sea bass are not overfished and overfishing is not occurring. Incorporation of a revised time series of MRIP data and data on the large 2015 year class contributed to an increase in estimated stock biomass compared to the previous assessment.

The distribution of the fishery and catches has shifted north over the past decade. Most survey aggregate biomass indices are near their time series high. Recent survey indices suggest the recruitment of a large 2011 year class in the northern region and a strong 2015 year class in both regions. The spawning biomass is well above the management target.

Current Management Measures

The coastwide commercial fishery is allocating 49% of the total allowable catch and the recreational sector is allocating the remaining 51%.[2] In a given fishing season,

excess commercial quota in one state can be transferred to another state which has exceeded its quota. The allocation will change to 55% recreational and 45% commercial in January of 2023.

The Maryland commercial black sea bass fishery is managed through limited entry. A permit transfer from a licensed fisherman is required to enter the fishery, and individual fishing quotas are assigned to each black sea bass permit holder. Quota reserved for permit holders who do not enter the fishery is reallocated among declared permit holders. However, an individual is not allowed to have >20% of the quota. Overages are deducted from the following year's quota allocation. Quota is allocated among four commercial sectors: 87% pots, 11% trawl, 1% hook and line, and 1% for all other fishing gear. Licensed commercial fishermen without a commercial black sea bass permit card are limited to landing 50 pounds (lbs) per day. The commercial fishery has an 11 inch minimum size limit.

In Maryland, almost all of the recreational black sea bass fishery occurs in federal waters. Maryland's recreational fishery (including federal waters) in 2020 was managed with a 12½ inch minimum size, 15 fish per person per day creel, and was open May 15, 2021 through December 31, 2021.[3] Since 2012, states have worked together to establish regional regulations to comply with ASMFC requirements (conservation equivalency). Since that time Maryland has been in a region with Delaware, Virginia, and North Carolina for recreational black sea bass management.

The Fisheries

A permit is required to commercially land more than 50 lbs of black sea bass per day in Maryland. In 2021, there were eleven pot fishermen and three trawlers that met the minimum requirements to receive a Maryland black sea bass landing permit. Preliminary 2021 commercial landings from Maryland were 482,233 lbs (Figure 1).

Maryland's 2021 recreational black sea bass catch was estimated at 212,050 fish (proportional standard error (PSE) 29.6) with a total weight of 278,677 lbs[4] (PSE30.9; Personal Communication from the National Marine Fisheries Service, Fisheries Statistics Division. Accessed April 21, 2022: Figure 2).

Issues/Concerns

Black sea bass population dynamics and tagging studies indicate they have regional rather than coastwide migrations. Adult fish prefer habitats near structures such as reefs and shipwrecks and exhibit seasonal site fidelity (the tendency to return to a previously occupied location). In the mid-Atlantic, black sea bass display site fidelity in the summer and migrate offshore to areas south of New Jersey in the winter. In contrast, adults in the South Atlantic do not migrate during the winter. As a result, regional management has been implemented and incorporated into the coastal management framework and is evaluated on a yearly basis.

Figure 1. Black sea bass harvested by the commercial fishery in Maryland: 1990 – 2021. Maryland catch records.

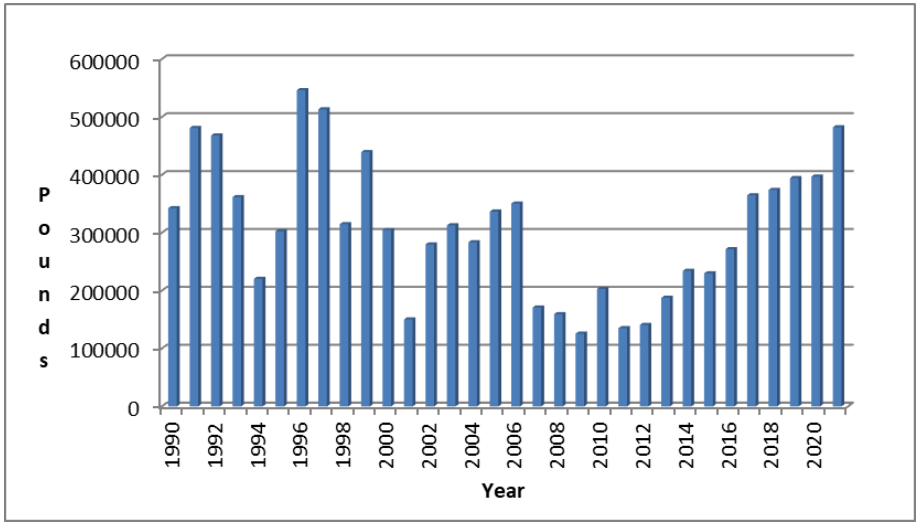
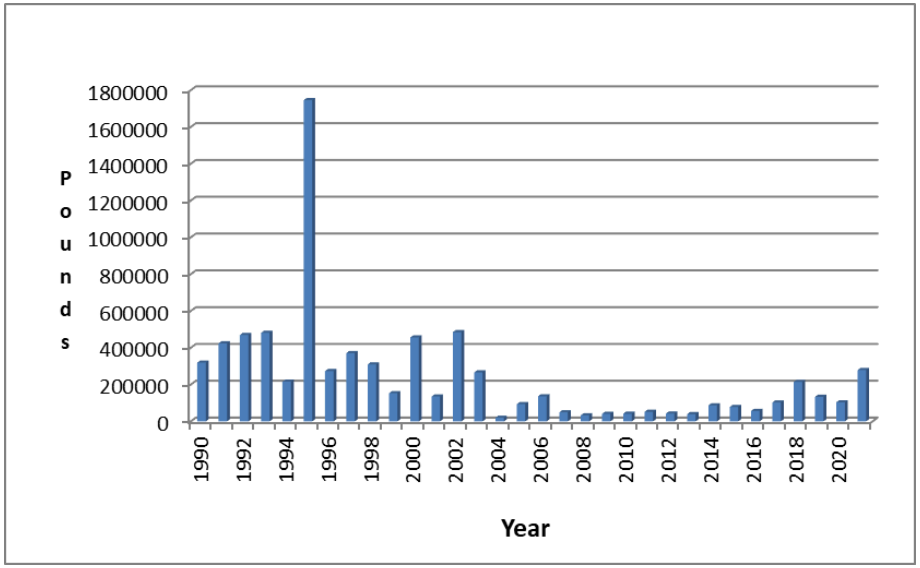


Figure 2. Estimated recreational harvest of black sea bass from Maryland: 1990-2021.[4]



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[1] Northeast Fisheries Science Center. 2019. Black sea bass operational assessment. US Dept. Commerce, Northeast Fisheries Center. https://asmfc.org/resources/science/stock-assessment/black-sea-bass-management-track-assessment-report-2024/

[2] Atlantic States Marine Fisheries Commission. 2013. 2013 review of the Atlantic States Marine Fisheries Commission fishery management plan for the 2012 black sea bass fishery: Black sea bass (*Centropristis striata*). Atlantic States Marine Fisheries Commission, Alexandria, VA.

[3] Doctor, S. 2022. Maryland's 2021 black sea bass (*Centropristis striata*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources, Annapolis, Maryland.

[4] National Marine Fisheries Service, Fisheries Statistics and Economics Division. Marine Recreational Information Program. Accessed April 21, 2022. nmfs.noaa.gov/recreational-fisheries/access-data/run-a-data-query/queries/index.

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table			
Strategy	**Action**	**Date**	**Comments**
1.1) Reduce fishing mortality, increase YPR and provide more escape opportunities for small BSB to the spawning stock. A maximum spawning potential level of 22-30% should be achieved.	1.1A) The Bay jurisdictions will implement a 9" minimum size limit for commercial and recreational BSB fisheries in year 1 (1996) and year 2 (1997) of the plan. Beginning in year 3 (1998), the minimum size will be determined by MAFMC on an annual basis. Regulations will be written so that they are applicable to all fish landed in a state, whether caught in state or federal waters.	1996 2003 2003 2004 2009 2014 Continue	BSB have exceeded the survey index since 2003 and are not considered overexploited. The minimum size limit for the commercial fishery was 11 inches and for the recreational fishery was 11.5 inches with a 25 fish/day /person creel limit. In MD, individual commercial BSB quota and limit are identified on a BSB permit card. Non permitted individuals are limited to landing ≤50 lbs in MD & VA with an 11" minimum size limit for the commercial fishery. MD recreational minimum BSB size limit increased to 12.5"with a creel limit of 25/person/day VA recreational minimum BSB size limit increased to 12.5"with a creel limit of 25/person/day. MD & VA reduced their recreational creel to 15 fish/person/day and maintained the 12.5" size limit.
	1.1B) Based on the MAFMC Monitoring Committee's evaluation of the success of the FMP relative to the overfishing reduction goal, additional restrictions such as seasonal closures, creel limits, quotas, and limited entry, may be established.	2002 Continue 2003 Continue 2010 2013 2015-2016 2010 2012 2015-2016	Amendment 13 of the MAFMC and ASMFC's Summer Flounder, Scup and BSB FMP changed the management of the commercial fishery from coastal quarterly quotas to state by state allocations. MD is allotted 11% of coastwide landings and VA is allotted 20%. The BSB fishery is open year round in MD & VA until quota is met. MD & VA implemented recreational closures from January 1 to May 21 and October 12 to October 31. Closure was revised to January 1-May 18 and September 19-October 17. Closure adjusted to January 1 to May 14 and September 22 to October 21. Stock was assessed in 2010. The black sea bass coastal stock is not overfished and overfishing is not occurring based on 2012 revised BRPs. Benchmark coastal stock assessment completed in 2016. The stock is not overfished and overfishing is not occurring. Next stock assessment update is scheduled for late 2018.

		2018 2019	Benchmark assessment was completed using a two region stock. The stock is not overfished and overfishing is not occurring. Operational update to the stock assessment was completed using new MRIP recreational estimates. The stock is not overfished and overfishing is not occurring.
1.2) Management agencies will require the use of escape panels, trawl efficiency devices, selective mesh sizes, culling devices and/or other methods to promote gear efficiency and reduce bycatch.	1.2A) VA, MD, and PRFC will investigate the potential for innovative devices designed to reduce the bycatch of juvenile finfish in non-selective fisheries. Continued testing of these bycatch reduction devices will be encouraged.	2000 Continue	PRFC tested plastic escape panels for pound nets. The device can provide escapement for up to 80% of undersized fish.
	1.2B) VA and MD will work with MAFMC/ASMFC to develop and require the use of more efficient gear consistent with policies designed to reduce bycatch and/or discards.	As specified	No specific gear alterations have been recommended.
	1.2C) VA and MD will implement a mesh size of 4.0 inch diamond mesh for trawl vessels harvesting more than 100 lbs of BSB per trip. Changes in minimum mesh size will be implemented based on MAFMC/ASMFC recommendations. VA will continue its ban on trawling in state waters. PRFC will continue its ban on Potomac River.	1996 1980 1981 1992 2004 Continue	Mesh size requirements for the commercial fishery are appropriate for the minimum size requirements. COMAR 08.02.05.21: Minimum mesh: larger nets are required to possess a minimum of 75 meshes of 4 ½” diamond mesh in the cod-end or the entire net must have a minimum mesh size of 4 ½” throughout; smaller nets must have 4 ½” mesh or larger throughout. Maximum roller rig trawl roller diameter ≤ 18”
	1.2D) VA and MD will require escape vents in BSB pots, based on the recommendations of MAFMC/ASMFC. The minimum size requirements will be considered after the MAFMC completes its study on escape vents.	Continue 1996 1996 1996	Chesapeake Bay Program (CBP) jurisdictions are in compliance with vent requirements in pots and traps. COMAR 08.02.05.21: Unobstructed escape vent in holding chamber of at least 2 ½” diameter, if circular, or 2 ½” stretched mesh size if square. 4VAC20-950-40: Two escape vents of 2 ½” circular dimension, 2” square dimension, or 1 3/8” by 5 ¾” rectangular dimension. MD & VA require hinges or fasteners on one side panel or door made of the following materials: a) Untreated hemp, jute, or cotton string of 3/16” or less diameter; b) Magnesium alloy, timed float releases (pop-up devices), or similar magnesium alloy fasteners; or c) ungalvanized or uncoated iron wire of 0.094” or less in diameter.
	1.2E) The jurisdictions will define a BSB pot for enforcement requirements as recommended by the MAFMC.	2002	Was not defined because CBP jurisdictional commercial fishermen use lobster pots and fish traps to catch both lobster and black sea bass.

		2008	COMAR 08.02.05.02: (9) "Fish pot" means a single, finfish entrapment net device, without associated wings or leads, consisting of: (a) An enclosure of various shapes covered with wire, fabric, or nylon mesh webbing of not less than 1 ½" stretched mesh size; (b) One or more conical entrance funnels; (c) One or more unobstructed escape vents, in the holding chamber, of at least 2 ½" in diameter, if circular, or 2 ½" stretched mesh size if square. Definition relocated to COMAR 08.02.25.01 in 2013. VA does not have a fish pot definition.
	1.2F) VA and MD will require that BSB pots and traps have biodegradable hinges and fasteners on one panel or door.	1996 Completed 2002 2020	MD & VA require hinges or fasteners on one side panel or door made of the following materials: a) Untreated hemp, jute, or cotton string of 3/16" or less diameter; b) Magnesium alloy, timed float releases (pop-up devices), or similar magnesium alloy fasteners; or c) ungalvanized or uncoated iron wire of 0.094" or less in diameter. Pots and traps having wooden slats will remove one set of parlor slats so it is 1 1/8" apart. Federal regulations require two escape vents located in the parlor portion of the trap. Maryland regulations were corrected effective March 2020 to reflect the requirement.
2.1) VA and MD will work with the Institute of Marine Science, Old Dominion, and University of Maryland to promote research concerning the effects of sex-reversal. The stock assessment departments of VMRC, MD DNR, and PRFC will continue to collect information on size composition in commercial catches as part of a coastwide effort to monitor the effects of minimum sizes on BSB stocks.	2.1A) Research on effects of hermaphroditism on yield, spawning stock and other parameters will be encouraged. VMRC's stock assessment department, in cooperation with VIMS, will attempt to determine the appropriate size at which sex reversal takes place for BSB in this region.	Continue 2009	Although the stock has been rebuilt, management measures have been kept conservative because of unknown population dynamics due to hermaphroditism. Increased uncertainty in the stock assessment model was incorporated because black sea bass are protogynous hermaphrodites.
	2.1B) VA will continue its annual VIMS Trawl Survey, of estuarine finfish species and crabs found in VA Bay waters, to measure size, age, sex, distribution, abundance, and catch-per-unit-effort (CPUE).	1997 2002 Continue	BSB were sporadically caught during the 2002-2006 trawl surveys. The majority of BSB abundance and biomass exist in Virginia waters of the Chesapeake Bay. Typically, BSB are first observed during the summer and peak during the fall portions of the survey. BSB may be observed during spring trawls.
2.2) The jurisdictions will promote research to define movements and mortality of BSB between state and federal waters.	2.2A) VMRC's Stock Assessment Program will continue to collect biological data (age, size, sex) from commercial catches of BSB.	Continue	Biological data is used for the coastal stock assessment.
	2.2B) Research on migration of BSB between inshore and offshore areas will be encouraged. Tagging experiments to provide data on BSB migration may be funded from sales of VA saltwater fishing licenses.	Continue	In VA, black sea bass is 1 of 10 species currently being tagged in the Virginia Volunteer Angler Gamefish Tagging Program.

	2.2C) PRFC will collect information on BSB harvested and discarded in the Potomac River pound net fishery as part of a two year pound net study funded by the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA).	Continue	PRFC continues to collect BSB harvest data.
2.3) MD, VA and PRFC will continue to support interjurisdictional efforts to maintain a comprehensive database on a baywide scale.	2.3A) The jurisdictions will collect information on commercial landings.	2008 2010 2017	MD does not have a fishery-dependent monitoring program. Data is occasionally collected from the recreational for-hire fishery. Northeast Data Poor Stocks Working Group determined that BSB are undergoing overfishing, but the stock is not overfished. ASMFC Technical Committee declared the stock rebuilt. Revised BRPs are $F_{40\%}$ = 0.42 and $SSB_{40\%}$ = 27.6 million lbs. Overfished threshold is $SSB_{threshold}$ = 24.0 million lbs. Preliminary commercial landings for 2017 are 364,731 lbs.
	2.3B) VA will continue to supplement MRFSS data with more detailed catch statistics at the state level.	1996-1997 2012 2017	MRFSS is used to collect recreational catch data. MRFSS replaced with the MRIP survey. Estimated recreational landings for 2017 from Maryland was 102,656 lbs and from Virginia was 59,988 lbs (MRIP June 2018).
	2.3C) MD will require mandatory reporting for all black sea bass landed in Maryland, wherever harvested.	Continue	Data is included in commercial fishery statistics.
3.1a) Restoration of aquatic reefs would lead to increased habitat for black sea bass. Jurisdictions will continue to expand and improve their current oyster restoration programs with periodic program evaluations to ensure maximum success. Specific attention should be focused on aquatic reefs in the salinity range of the black sea bass.	3.1a.A) MD and VA will continue implementation of the 1994 Oyster FMP which combines the recommendations of both the VA Holton Plan and the MD Roundtable Action Plan.	Continue 2008 2010	CBP jurisdictions developed a 2004 Oyster Management Plan (2005) which combines the FMP and habitat objectives. It includes reef development using reclaimed and fresh oyster shells, oyster repletion and oyster sanctuary and harvest reserve areas. Maryland is currently managing oyster restoration under the Maryland 10-point Action Plan. *Crassostrea virginica* (native oyster) and not *Crassostrea ariakensis* (Asian oyster) will be used for reef development following the Environmental Impact Statement for Oyster Restoration in Chesapeake Bay Including the Use of a Native and/or Nonnative Oyster. Maryland is implementing a 10-point Oyster Restoration and Aquaculture Development Plan. The plan increases the network of oyster sanctuaries from 9% of available habitat to 25%. The priority targeted restoration areas are Harris Creek, Tred Avon and Little Choptank.

		2016	The management of oyster sanctuary areas was reviewed and a final draft report completed in July 2016. To access the document, go to: http://dnr.maryland.gov/fisheries/Pages/oysters/5-Year-Oyster-Review-Report.aspx
		2019	A new fishery management plan for oysters was adopted in 2019. The 1994 plan is no longer in use.
	3.1a.B) MD and VA will continue the implementation of the Aquatic Reef Habitat Plan.	2007 Continue	Artificial Reef Committee (ARC), Maryland Artificial Reef Initiative (MARI), and Maryland's Artificial Reef Management Plan were developed and several reefs have been created in the Chesapeake Bay and the Atlantic Ocean.
		Continue	Reefs are qualitatively monitored with underwater video.
		2010 Continue	ARC and MARI began support for shallow water (<20 ft.) reef projects. For a complete list of reef sites go to http://dnr.maryland.gov/fisheries/Pages/reefs/locations.aspx
3.1b) The creation of new artificial reefs and the expansion and improvement of preexisting reefs will provide additional habitat for the BSB population.	3.1b.A) Jurisdictions will continue to maintain, expand, and improve their artificial reef programs.	Continue	In VA, artificial reefs are being funded through Recreational Advisory Board. All artificial reefs created by funds from recreational license revenues adhere to the gear type prohibition.
		1996-2006	MD terminated its program in 1996. Artificial reef development was administered in the Chesapeake Bay by MD Environmental Service and in the Atlantic Ocean by the Ocean City Reef Foundation (OCRF).
		2007	MD Artificial Reef Committee and the MD Artificial Reef Initiative (MARI) were established to develop reefs in cooperation with OCRF. Both MARI and OCRF accept private donations while MD contributes funds when available for reef development projects.
		2008	44 NY subway cars were deployed off Ocean City.
		2011	USN Destroyer *Radford* was reefed on August 10, 2011. The vessel has since broken into 3 pieces but remains upright.
		2017	Artificial reef materials (e.g. Concrete, reef balls, etc.) have been placed at four sites in the Chesapeake Bay with an estimated total area of 45,400 ft^2.

2018

The following were deployed off Ocean City: a 60 foot barge at Capt. Bob Gowar's Memorial Reef (May), a 55 foot barge at Capt. Jack Kaeufer's Memorial Reef (July), and a 50 foot barge in honor of Capt. Greg Hall, an OCRF co-founder (December).

2018

The following deployments were made in the Maryland portion of the Chesapeake Bay:

Location	Material description	Quantity	# of Deployments	Total Area (est)
Love Point	Concrete road barriers, deck slabs, piling cutoffs, and rubble	6,200 tons concrete	7	33,400 ft^2
Tilghman Island	Mixture of "Mini Bay Ball" and "Lo-Pro" concrete reef balls	140 reef balls (~9 tons @ 130 lbs ea.)	2	4,200 ft^2
Tangier Sound	Steel deck barge	120' steel barge	1	3,600 ft^2

2019

The following were deployed: a 130 foot barge at Jackspot (January), and 20+ truckloads of precast concrete such as pipe & junction boxes (May).

Block deployments now number beyond 27,600.

Manufacturing of molds began for a 160 lb concrete pyramid. The pyramids look to be highly usable and deployable by hand from a small boat.

2020
2021

Coastal reef building efforts as of August 2021:

- 34,747 reef blocks and 355 concrete reef pyramids (170 lbs each) deployed at numerous ACE permitted ocean reef sites
- 119 reef pyramids in Chesapeake Bay

2020
2021

Reef building efforts in progress:

- Virginia Lee Hawkins Memorial Reef: 99 reef blocks and 53 reef pyramids

			• Capt. Jack Kaeufer's/Lucas Alexander's Reefs: 1,856 reef blocks and 44 reef pyramids • Doug Ake's Reef: 4,114 reef blocks and 16 reef pyramids • St. Ann's: 2,725 reef blocks and 8 reef pyramids • Sue's Block Drop: 1,562 reef blocks and 20 reef pyramids • TwoTanks Reef: 1,223 reef blocks and 11 reef pyramids • Capt. Bob's Inshore Block Drop: 912 reef blocks • Benelli Reef: 1,491 reef blocks and 15 reef pyramids • Rudy's Reef: 465 reef blocks • Capt. Bob's Bass Grounds Reef: 3,414 reef blocks and 52 reef pyramids • Wolf & Daughters Reef: 734 reef blocks • Al Berger's Reef: 979 reef blocks and 11 reef pyramids • Great Eastern Block Drop: 1,074 reef blocks and 10 reef pyramids • Unnamed reef near Russell's Reef: 30 reef blocks and 49 reef pyramids • Capt. Greg Hall's Memorial Reef: 92 Tog monster blocks and 2 reef pyramids
	3.1b.B) VA recently prohibited use of all gear except recreational rod and reel, hand-line, spear, or gig on four artificial reefs in state waters.	1998 Continue	MD and VA adopted legislation that prohibits hydraulic clamming (and crab dredging in VA) in or near SAV beds.
3.2) Jurisdictions will continue efforts to "achieve a net gain in submerged aquatic vegetation distribution, abundance, and species diversity in the Chesapeake Bay and its tributaries over current populations.	3.2a) Protect existing SAV beds from further losses due to degradation of water quality, physical damage to plants, or disruption to the local sedimentary environment as recommended by Chesapeake Bay SAV Policy Implementation Plan. • Protect SAV and potential SAV habitat from physical disruption. Implement a tiered approach to SAV protection, giving highest priority to protecting Tier I and II areas but also protecting Tier III areas from physical disruption. • Avoid dredging, filling or construction activities that create turbidity sufficient to impact nearby SAV beds during the SAV growing season. • Establish an appropriate undisturbed buffer around SAV beds to minimize the direct and indirect impacts on SAV from activities that significantly increase turbidity. • Preserve natural shorelines. Stabilize shorelines, when needed, with marsh plantings as a first alternative. Use structures that cause the smallest	Continue 2003 2008 2011 2014	MD implemented a living shorelines program in 1970 to encourage vegetative shoreline stabilization. Regulations are in place to prohibit dredging through SAV beds. Tiered designation and prioritization of SAV beds has not been implemented. Avoidance of dredging, filling and construction impacts to SAV is strictly enforced by MDE and USACE with input from MD DNR, USFWS, and NMFS. MD has not established undisturbed buffers. VA has established buffer criteria. The revised SAV goal adopted by Chesapeake Bay Program is restoration of 185,000 acres of SAV by 2010 and planting 1,000 acres of SAV by 2008. Only 15% of the restoration target was met by 2008. There's been very little long-term survival from SAV plantings.

	increase in local wave energy where planting vegetation is not feasible. • Educate the public about the potential negative effects of recreational and commercial boating on SAV and how to avoid or reduce them.	2017 Continue	MD legislated that shoreline stabilization projects must use living shoreline techniques unless demonstrated to be infeasible. STAC reviewed the SAV restoration projects during 2011and concluded that the projects were operationally successful but functionally unsuccessful. The restoration planting goal was revised to 20 acres per year. A new Chesapeake Watershed Agreement was adopted (June 2014) to achieve the ultimate goal of 185,000 acres of SAV baywide with a target of 90,000 acres by 2017 and 130,000 acres by 2025. An estimated 104,843 acres of SAV were observed in 2017 and has exceeded the interim target of 90,000 acres. Virginia Institute of Marine Science continues a yearly flyover of the Maryland coastal bays to quantify and identify the extent of SAV beds in Maryland waters, both Chesapeake and coastal. Maryland Coastal Fisheries program yearly assesses the fish life in selected coastal areas by seine studies.
	3.2b) Set and achieve regional water and habitat quality objectives that will result in restoration of SAV through natural revegetation as recommended by the Chesapeake Bay SAV Policy Implementation Plan.	Continue	Water quality criteria have been adopted. https://www.chesapeakebay.net/issues/threats-to-the-bay/nutrient-runoff
	3.2c) Set regional SAV restoration goals in terms of acreage, abundance, and species diversity considering historical distribution records and estimates of potential habitat as recommended by the Chesapeake Bay SAV Policy Implementation Plan.	2003 2011 Continue 2014 2015 Continue	Bay wide SAV restoration goal was 1,000 acres planted by 2008. In 2012, the restoration planting goal was revised to 20 acres per year. Little progress has been made since 2010 and a SAV restoration goal was not included in the new Chesapeake Watershed Agreement. One acre was planted in 2013. Tracking of this indicator was discontinued in 2014 with a programmatic focus on restoring water clarity and protecting existing Bay grass beds. SAV covered 59,927 acres in 2013. SAV increased 27% to 75,835 acres in 2014. This increase is attributed to a rapid expansion of widgeongrass and a modest recovery of eelgrass. Between 2014 and 2015, SAVs increased by 21% for a total of 91,621 acres. This marks 3 years of consecutive growth. See

			Chesapeake Bay Program website for updates on SAV restoration. The 2017 estimate was 104,843 acres of SAVs. https://www.chesapeakebay.net/issues/whats-at-risk/underwater-grasses
3.3) Establish a goal of no net loss of wetlands and a long term goal of a net resource gain for tidal and nontidal wetlands as recommended in the Chesapeake Bay Wetlands Policy.	3.3) Jurisdictions should strive towards achieving the following, especially in the salinity range of BSB. • Define the resource through inventory and mapping activities. • Protect existing wetlands. • Rehabilitation, restoring and creating wetlands. • Improving education. • Further research.	2006 Continue Continue 2006 Continue 2009 Continue 2012 2014	Programs have been expanded to the tributaries. GIS mapping activities are underway to target protection and restoration efforts for habitat resources, but habitats are not targeted for a single, specific species' benefit. MD developed a Blue Infrastructure that includes mapping of BSB habitats such as structural habitat and SAV. MD developed a Blue Infrastructure that includes mapping structural habitat and SAV. Wetland mosquito ditches from the 1930s-1940s are being plugged to reduce tidal flow and restore wetland hydrology and function. Wetland enhancement and restoration is tracked cumulatively among tidal and non-tidal wetlands and salinity regimes. Between 2010 and 2012, wetland acres established or re-established in MD equal 1,646 and in VA equal 16,853. Wetland acres enhanced or rehabilitated from 2010-2012 in Chesapeake Bay watershed was 5,503. See Chesapeake Bay Program website for updates on wetland rehabilitation and restoration. https://www.chesapeakeprogress.com/abundant-life/wetlands
3.4) Jurisdictions will continue efforts to improve baywide water quality through the efforts of programs established under the 1987 Chesapeake Bay Agreement. In addition, the jurisdictions will implement new strategies, based on recent program reevaluations, to strengthen deficient areas.	3.4a) Based on the 1992 baywide nutrient reduction plan reevaluation, the jurisdictions will: • Expand program efforts to include tributaries. • Intensify efforts to control nonpoint sources of pollution from agriculture and developed area. • Improve on current point and nonpoint source control technologies.	Continue 2009 2012/2014	Maps that indicate regions of concerns for living resources have been developed. President Obama executive order recommitting federal agencies to Bay restoration and regulatory enforcement. The Chesapeake Bay Program and Chesapeake Bay jurisdictions signed a new Watershed Agreement with 2 year milestones for nutrient reduction and water quality improvement. See Chesapeake Bay Program website for updates on nutrient reduction. https://www.chesapeakeprogress.com/clean-water#water-quality

		2020	The Maryland Coastal Bays Program (MCBP) is a National Estuary Program which exists to protect and conserve the waters and surrounding watershed of Maryland's coastal bays to enhance their ecological values and sustainable use for both present and future generations. Through education and outreach programs, numerous restoration projects, and local partnerships, MCBP works to improve water quality, protect habitat, and enhance forests and wetlands. Projects have included: wetland creation on an abandoned sand gravel mine that annually removes over 1,000 lbs of nitrogen from entering the St Martin River; restoration of eroding shoreline at Assateague State Park that was estimated to annually remove 44 lbs of nitrogen, 3 lbs of phosphorus and 164 tons of sediment from Sinepuxent Bay; numerous stormwater retrofits that reduce nitrogen and phosphorus in stormwater from entering the coastal bays; and restoration of hydrology to allow better stormwater infiltration into the headwaters of Ayers Creek, Newport Bay. Projects have also included restoration of fish passage to freshwater spawning grounds of anadromous fishes.
	3.4b) Based on the 1994 Chesapeake Bay Toxics Reduction Strategy Reevaluation Report, the jurisdictions will emphasize the following four areas: • Pollution Prevention: Target "Regions of Concern" and "Areas of Emphasis. • Regulatory Program Implementation: Ensure that revised strategies are consistent with and supplement pre-existing regulatory mandates. • Regional focus: Identify and classify regions according to the level of contaminants. • Directed Toxics Assessment: Identify areas of low level contamination, improve tracking and control of non-point sources.	Continue	See Chesapeake Bay Program website for updates on nutrient reduction. https://www.chesapeakeprogress.com/clean-water#toxic-contaminants Chesapeake Bay Program is monitoring levels of mercury, PCBs, PAHs, organophosphate and organochloride pesticides.
	3.4c) The jurisdictions will continue to develop, implement and monitor their tributary strategies to improve bay water quality.	2003 2010 2017	Ambient water quality criteria of DO, water clarity, and chlorophyll-a have been adopted for the Chesapeake Bay (April 2003). EPA's Phase I TMDL requirements (WIP development) completed. Phase II requirements have been initiated. Targets and progress will be evaluated in 2017 and Phase III WIPs will be developed.

Acronyms

ARC – Artificial Reef Committee
ASMFC – Atlantic Marine Fisheries Commission
BSB – Black Sea Bass
CB – Chesapeake Bay
COMAR – Code of Maryland Regulations
CPUE – Catch per Unit Effort
DO – Dissolved Oxygen
EPA – Environmental Protection Agency
F – Fishing Mortality
FMP – Fishery Management Plan
GIS – Geographic Information System
MAFMC – Mid-Atlantic Fisheries Management Council
MARI – Maryland Artificial Reef Initiative
MD – Maryland
MD DNR – Maryland Department of Natural Resources
MDE – Maryland Department of the Environment
MRFSS – Marine Recreational Fisheries Statistics Survey
NMFS – National Marine Fisheries Service
PAH – Polycyclic Aromatic Hydrocarbon
PCB – Polychlorinated Biphenyl
PRFC – Potomac River Fisheries Commission
RHL – Recreational Harvest Limit
SAV – Submerged Aquatic Vegetation
SSB – Spawning Stock Biomass
STAC – Scientific and Technical Advisory Committee
TAL – Total Allowable Catch
TMDL – Total Maximum Daily Load
USACE – U.S. Army Corps of Engineers
USFWS – U.S. Fish and Wildlife Service
VAC – Code of Virginia
VIMS – Virginia Institute of Marine Science
VMRC – Virginia Marine Resource Commission
WIP – Watershed Implementation Plan
YPR – Yield per Recruit

2021 Maryland FMP Report (December 2022)
Section 7. Blue Crab (*Callinectes sapidus)*

Total estimated abundance of blue crabs declined to a survey low of 227 million crabs based on the 2021-2022 bay wide winter dredge survey (WDS). The abundance of spawning age females decreased in 2022 to 97 million crabs but is above the threshold of 72.5 million crabs. Female harvest was at a sustainable level for the 14th year in a row. Even though the blue crab population is not depleted and overfishing is not occurring at this time, due to three consecutive years of below average juvenile abundance and declines in both adult male and female populations, precautionary management measures are recommended to ensure that neither the female-specific management thresholds, nor the male conservation trigger are exceeded.

Chesapeake Bay Blue Crab Management

The Chesapeake Bay Program (CBP) adopted a Blue Crab Fishery Management Plan (CBBC FMP) in 1989. The plan was revised in 1997 with the following objectives: provide long-term protection for the blue crab stock; maintain a stable stock size; establish quantitative targets (such as abundance, biomass, or other indices) and biological reference points. In 2003, Amendment 1 to the 1997 CBBC FMP was adopted. The purpose of Amendment 1 was to formally adopt biological reference points for managing the resource; to reaffirm strategies for reducing fishing effort, and to recognize the importance of biological monitoring, habitat protection and ecosystem processes. Amendment 2 was developed in 2011 to formally adopt new female-specific reference points, and to recognize the importance of fishery-independent and fishery-dependent monitoring. Amendment 2 was incorporated by reference into Maryland regulation in September 2012. The CBBC FMP and amendments will undergo an in-depth review, if the results of an annual stock assessment update determine one is necessary.

Stock Status

The Chesapeake Bay blue crab stock is currently not overfished and overfishing is not occurring. The last full stock assessment, using survey data through 2010 was completed, and peer reviewed in 2011. The 2011 stock assessment used an integrated estimate of management reference points and stock status. Previous stock assessments did not directly link the two parameters. Since 2011, stock status has been monitored annually using empirical calculations of exploitation rate and abundance from the WDS in relation to the female specific biological reference points (BRPs) from the 2011 assessment. In 2017, the Maryland Department of Natural Resources (MD DNR) and the Virginia Marine Resource Commission (VMRC) decided to complete an assessment update with an additional six years of data added to the time series. The assessment update was completed using the same sex-specific Catch Multiple-Survey model employed in the 2011 assessment, with the longer time period of data. The 2017 stock assessment update recommended revised targets and thresholds for the BRPs (i.e. spawning female abundance and female exploitation fraction), which the Bay jurisdictions formally adopted in November 2020.

The Chesapeake Bay Stock Assessment Committee (CBSAC) annually reviews the results of blue crab surveys and harvest data in relation to the BRPs, to assess the status of the stock, and to provide management advice. The spawning female abundance BRP is based on the abundance of age 1+ female crabs (an index of the spawning stock) and is used to determine if the stock is overfished. The number of spawning age female crabs decreased from 158 million in 2021 to 97 million crabs in 2022, which is above the threshold of 72.5 million crabs but below the recommended target abundance of 196 million. The female exploitation fraction BRP is the percentage of female crabs (age 0+) removed from the stock and is used to determine if overfishing is occurring. At the time of review in 2021 the exploitation fraction was 26%, but as more harvest data are finalized, the female exploitation rate may exceed the target of 28%. The status of the stock from 2011-2022 based on the female-specific targets and thresholds can be found in Table 1.

In order to ensure that male abundance does not drop below a critical level relative to female abundance, the Bay jurisdictions developed conservation points of reference for male crabs. The points of reference were updated in 2014 to include a scaling factor that is consistent with the way the female BRPs are calculated. The CBSAC recommended the following conservation trigger for male crabs: if the male exploitation rate exceeds 34%, the Bay jurisdictions should consider conservation measures for male crabs. The male conservation trigger was based on the second highest exploitation value in the time series of data and does not represent a biologically significant parameter. The 2021 estimate of male exploitation was 31% but as more harvest data are finalized, the male exploitation rate may exceed the conservation trigger. For this reason the CBSAC recommends precautionary management measures.[1]

In addition to reviewing adult male and female abundance the CBSAC also monitors the WDS estimate of recruitment, which is the number of juvenile crabs (crabs less than 60 mm or 2.4 in). Estimated juvenile abundance increased from a survey low of 86 million in 2021 to 101 million crabs, which is the second lowest abundance in the time series.

Despite achieving female management objectives since 2008, the population has not produced a good year class in the most recent three years, raising concerns the

population dynamics of Chesapeake Bay blue crabs has changed or the stock assessment's modeling is no longer appropriate for the population, prompting CBSAC to recommend a new benchmark stock assessment be conducted.

Management Measures

A control rule for the blue crab stock has been used to assess the status of the stock since 2001. Control rules describe a variable as a function of another variable that management can influence or have some control over.[2] Determining the variables depends on the characteristics of the stock and the fishery. These variables are then used to develop definitions of biological reference points, i.e., targets and thresholds. In developing a control rule, the selection of a target is risk-averse, even though it is expected that the target may be exceeded because of natural annual variability. Currently, the control rule for blue crabs is based on female spawning stock biomass and exploitation.

In Maryland, catch limits and closed periods are implemented to maintain an allowable female harvest that is associated with the 28% exploitation target. The allowable female harvest changes with estimated annual abundance. MD DNR determines the allowable harvest, and then develops a suite of limits designed to achieve, but not exceed the allowable harvest. The crabbing industry provides input on which combinations of limits work best for the industry, via the Blue Crab Industry Advisory Committee.

Bushel limits for the 2021 mature female crabbing season (April – November 30, 2021) remained the same as 2020 except for the one week extension in the October bushel limit that occurred in 2020. The spring bushel limits for 2022 will remain the same but due to low abundance estimates observed in the 2022 Winter Dredge Survey the mature female bushel limits will be lowered from July – November 2022. Additionally male bushel limits will be put into place for August and September 2022 and the season shortened by 2 weeks to end on November 30, 2022 for the commercial fishery, to ensure the male conservation trigger is not exceeded due to the low abundance of adult male crabs and the consecutive years of low juvenile abundance.

Similar conservation action will be imposed on the recreational fishery reducing recreational daily bushel limits to one bushel per day, per boat from July - December 15, 2022. The changes to recreational crabbing regulations that went into effect in 2013 are still in place. Waterfront property owners must register their crab pots in order to use them from their pier. Anyone using collapsible traps or net rings must obtain a recreational license. A person can use a hand-line or dip net to catch crabs without a license. Refer to the MD DNR webpage for more details: http://dnr.maryland.gov/fisheries/Pages/regulations/blue-crab.aspx

The Fishery

As population levels change, maintaining the exploitation target may result in either an increase or a decrease in harvest. The initial 2021 baywide (Maryland, Virginia, and Potomac River) commercial harvest was approximately 36.3 million lbs (Figure 2). The percentage of females removed by harvest in 2021 was approximately 26%, which was below the recommended target (28%) and threshold (37%) (Table 1). Prior to 2008, recreational harvest was assumed to be approximately 8% of the total harvest. Since recreational crabbers can no longer harvest female crabs in Maryland, the estimated harvest is now based on 8% of the baywide male harvest, plus 8% of Virginia female harvest for a total of 2.3 million lbs. In 2021, adding up the harvest from each fraction of the harvesting sectors and across the entire Chesapeake Bay, the 2021 total preliminary harvest was approximately 38.6 million lbs.[1] The harvest exploitation rate estimates are preliminary and may be updated when the harvest data are finalized.

Issues/Concerns

Although management measures have successfully kept the exploitation of female crabs below the target, and kept abundance above the threshold, conservation measures need to remain in place to ensure that the population continues to increase. In addition, a more comprehensive set of criteria for male crabs would be valuable in determining appropriate management measures when necessary. Large variations in the annual recruitment of blue crabs to the Chesapeake Bay are expected as it is largely driven by environmental factors. Due to the variation in recruitment, overwintering mortality and other unknown variables, the blue crab population is subject to high natural variability from year to year. These factors emphasize the need to determine an appropriate margin of conservation to account for environmental variability.

Since 2012, a pilot study led by an industry-based group has been utilizing a new way to accurately report commercial harvest data, in a more timely fashion, using electronic technology. This is a co-management approach between the crab harvesters and MD DNR. The electronic reporting program includes a "hail-in, hail out" protocol and random catch verification, which should provide improved and timely commercial harvest data.

Maryland has continued with a text messaging system to help watermen stay abreast of blue crab regulations and any seasonal changes that may occur. Watermen can subscribe to receive text message reminders a day or two before a regulation change goes into effect.

Latent effort refers to the number of people holding fishing licenses that have not been actively harvesting crabs. Latent effort poses a risk to the blue crab population if unused effort were to enter the fishery. The jurisdictions analyzed effort levels relative to abundance over time during 2017. At this point, effort has not changed in response to crab abundance, but the jurisdictions will continue to examine latent effort for any changes. Maryland and Virginia were successful at reducing the number of people holding crabbing licenses through a federally funded license buy-back program in 2009 and 2010. The number of inactive licenses continues to be monitored, and any changes may result in developing new recommendations.

New methods for calculating recreational catch and effort are needed to fully characterize total removals by the fishery. The CBSAC has recommended conducting a recreational catch and effort survey. The last surveys were conducted in 2002 and 2011, Virginia and Maryland, respectively. Recreational harvest from the Potomac River should also be included.

As part of the Sustainable Fisheries' goals in the Chesapeake Watershed Agreement (2014), blue crab abundance and management outcomes were developed. The abundance outcome states: "Maintain a sustainable blue crab population based on the current 2012 target of 215 million adult females. Refine population targets through 2025 based on best available science." The management outcome states: "Manage for a stable and productive crab fishery, including working with the industry, recreational crabbers and other stakeholders to improve commercial and recreational harvest accountability." The Bay jurisdictions developed a management strategy to achieve the outcomes and updated the work plan for 2022 and 2023. https://www.chesapeakeprogress.com/abundant-life/blue-crab-abundance/logic-action-plan

As part of addressing the blue crab management outcome, the jurisdictions, with stakeholder input, evaluated an allocation-based management framework: methods to allocate an annual blue crab total allowable catch for the Chesapeake Bay blue crab fishery. As a result of the evaluation, the jurisdictions will maintain the current blue crab management approach, and will not implement an allocation-based framework. https://www.chesapeakebay.net/channel_files/24399/allocation_update_to_bay_program_final_june_2017.pdf

Enforcement

The enforcement of commercial and recreational fishing regulations is critical to management success. In Maryland, the Natural Resource Police (NRP) has hired additional officers to provide a dedicated enforcement effort for crab management. The NRP has successfully increased the total number of enforcement hours and in the past, initiated a targeted enforcement protocol through a program called, "Don't Get Pinched." In addition, there have been increased penalties for offenses and improved judicial action.

Conclusion

CBSAC "recommends precautionary management measures in an effort to ensure that neither the female-specific management thresholds, nor the male conservation trigger, are exceeded to maintain a healthy spawning stock and to protect a sufficient fraction of this year's juvenile cohort to reach maturity and reproduce."[1] The CBSAC is also conducting a blue crab workshop to address science gaps related to juvenile recruitment success and population dynamics as well as identify potential enhancements to the stock assessment which will further help the Bay jurisdictions to investigate alternative strategies to improve management of the blue crab resource. Although steps have been made to improve harvest accountability and reporting for both the commercial and recreational fisheries, more improvements are needed. After three consecutive years of below average juvenile abundance and declines in both adult male and female populations, the jurisdictions will take precautionary management measures and make adjustments to ensure that harvest levels are commensurate with abundance indices.

References

[1] Chesapeake Bay Stock Assessment Committee (CBSAC). 2022. Chesapeake Bay Blue Crab Advisory Report, June 2022.

[2] Miller, T., Wilberg, M., Davis, G., Sharov, A., Colton, A., Lipcius, R., Ralph, G., Johnson, E., and Kaufman, A. 2011. Stock Assessment of the Blue Crab in Chesapeake Bay. Tech. Rept. Series No. TS-614-11 of the University of Maryland Center for Environmental Science.

[3] Restrepo, V. and J. Powers. 1999. Precautionary control rules in US fisheries management: specification and performance. ICES Journal of Marine Science, 56:846-852

Table 1. Female-specific biological reference points and status of the blue crab stock, 2011-2022.

Reference Points			Stock Status											
	Target	**Threshold**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Female-specific Exploitation Fraction	**28**%	**37**% (max)	24%	10%	23%	17%	15%	16%	21%	23%	17%	**23%**	26%	TBD*
Abundance (millions of female crabs)	**196**	**72.5** (min)	190	97	147	68.5	101	194	254	147	191	**141**	**158**	**97**

(2022 Chesapeake Bay Blue Crab Advisory Report)
*Exploitation fraction cannot be calculated until the 2022 harvest data is complete

Figure 1. Estimated abundance of spawning age female crabs (age 1+) in Chesapeake Bay, 1990-2022.

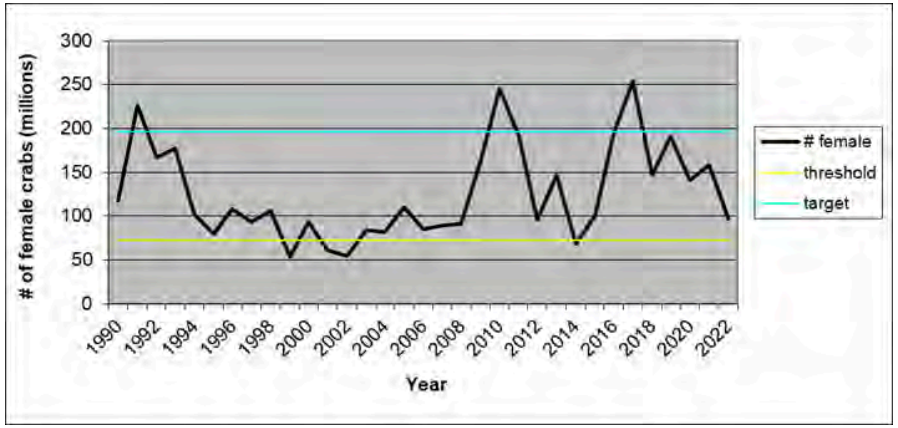
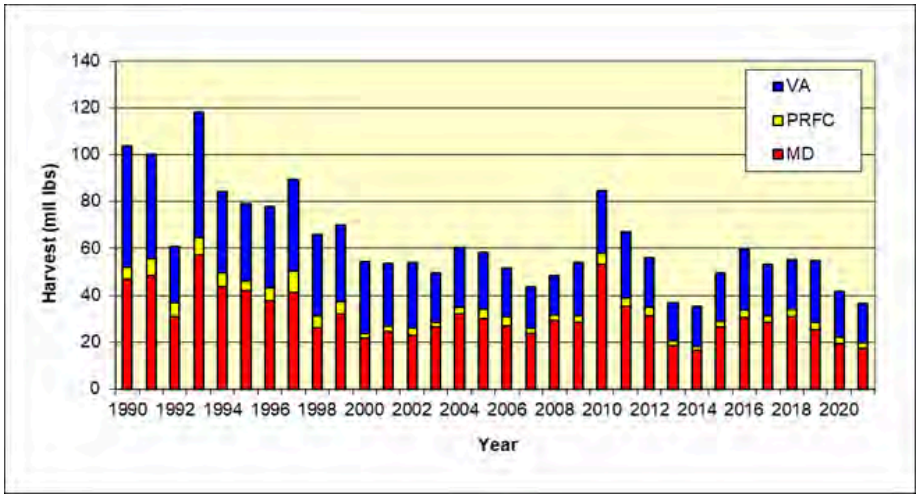


Figure 2. Chesapeake Bay Commercial Blue Crab Harvest, 1990-2021.



1997 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 2			
Problem Area	**Action**	**Date**	**Comments**
Stock Status Strategy Chesapeake Bay stock has stabilized at historically low levels, but continues to be at risk for recruitment failure.	1. CBP jurisdictions will adopt a threshold fishing mortality rate that preserves 10% of the blue crab spawning potential, relative to an unfished stock, and a minimum stock size threshold.	2003 Continue 2005 Continue 2010 2011 Continue 2020 2022	The use of BRPs began in 2001 and were formally adopted in 2003 with Amendment 1. The 2005 Stock Assessment recommended using the exploitation fraction (the proportion of the vulnerable population that is harvested each year) instead of F for evaluating BRPs. The 2010 exploitation estimate was below the threshold, and has been below the threshold since 2008. As a result of the 2011 stock assessment, new female-specific targets and thresholds were adopted. The female target and threshold are 215 million female crabs and 70 million female crabs, respectively. As a result of the 2017 stock assessment update, the female target was revised to 196 million female crabs and the female threshold to 72.5 female crabs. The revised target and threshold were adopted by the jurisdictions in November 2020. Female abundance (97 million crabs) is currently above the threshold level but below the target level.
	2. CBP jurisdictions will adopt a target fishing mortality of F_{20}, which if achieved, will increase the blue crab spawning potential from 10% to 20% relative to that of an unfished stock.	2003 Continue Continue 2020 2021	Using a target fishing mortality (F) began in 2001, and was formally adopted in 2003.The target fishing mortality (F) was replaced by the exploitation target of 46% in 2011 As a result of the 2011 stock assessment results, the female-specific exploitation target and threshold are 25.5% and 34%, respectively. In November 2020 the bay jurisdictions adopted an updated female-specific exploitation target and threshold of 28% and 37%, respectively. Based on preliminary harvest values, the 2021 female-specific exploitation was 26%, which is below the target level. An exploitation fraction for 2022 cannot be calculated until the completion of the 2022 fishery (December 2022).
	3. CBP jurisdictions will develop control rules based on the biological reference points (BRPs) for managing the blue crab resource. (The control rule was adopted in 2001 and updated in the 2005 stock assessment. It represents the relationship between adult crab abundance, exploitation and management reference points. It is a major improvement over the previous model because it	2003 2006 2008	Control rules were originally based on the entire crab population. In 2006, the overfishing limit was defined as 86 million age 1+crabs (threshold value). An interim target of 200 million age 1+ crabs was established in 2008.

	integrated the calculation of reference points within the model rather than using two separate processes as in the 2005 assessment)	2011 2022	Female-specific BRPs adopted in 2011. Based on the revised female BRPs adopted in 2020, the blue crab stock is not depleted and overfishing is not occurring.
	4. CBP jurisdictions will utilize the results of fishery-independent surveys to determine stock status.	Continue	Results of the 2021-2022 WDS indicated the abundance of female age 1+ crabs was 97 million crabs. Spawning-age crab abundance was above the threshold and considered not overfished.
Fishing Effort Strategy CBP jurisdictions will adjust fishing effort to achieve the adopted BRPs.	5. CBP jurisdictions will reduce the exploitation rate of legal-sized blue crabs to meet the target BRPs.	2008 Continue 2009 2010 2011 2021	The Bay jurisdictions implemented new regulations in 2008 & 2009 to reduce exploitation of female crabs. Harvest regulations have been adjusted as needed to meet the target exploitation rate. There is a large amount of latent effort in the blue crab fishery (fishing effort not currently utilized). MD implemented a buy-back program for LCC (limited crab catcher) licensees. VA also implemented a buy-back program, and utilized a reverse auction system. Between 2009 and 2010, MD reduced the LLC by about 700 licensees resulting in about a 35,000 pot reduction in effort In 2011, exploitation rates were changed to female-specific rates. Exploitation rates have been below the target since 2010 (Table 1). The 2021 baywide harvest was approximately 38.6 million lbs.
Monitoring Strategy CBP jurisdictions will collect fishery -dependent, and fishery-independent data on blue crab resources.	6. CBP jurisdictions will continue to monitor blue crab resources in the bay, and work towards developing a baywide monitoring approach.	Continue	The baywide winter dredge survey (WDS) provides an annual estimate of over-wintering blue crab abundance by age and gender and is the primary indicator of blue crab stock status in the Chesapeake Bay. Blue crab data is also collected from trawl surveys conducted by MD DNR and VIMS and used in the stock assessment model. In addition to the WDS and summer trawl survey MD DNR also conducts a voluntary cooperative data collection program to collect fishery-dependent size and sex composition data.
Habitat Strategy CBP jurisdictions will identify and protect critical blue crab habitat.	7. MD and VA will consider designating additional sanctuary areas to protect blue crab habitat, based on new research data.	Continue	The VA blue crab spawning sanctuary (928 square miles) was redesigned into 5 areas with separate closure dates. The EBFM life history brief indicates that blue crabs occupy a wide range of estuarine habitats, and utilize a series of habitats sequentially along a salinity gradient.
	8. CBP jurisdictions will continue to protect SAV in potential, post-larval settlement areas	Continue	SAV beds in near shore habitats provide essential habitat for blue crabs, especially during their post larval and juvenile stages. SAVs provide critical shelter for many key species besides crabs. SAVs help improve water clarity, add oxygen to the water, and reduce shoreline erosion.

	9. CBP jurisdictions will restore and protect SAV in the Chesapeake Bay to achieve the new goal of 185,000 acres by 2010.	Continue 2014 2021	Actions have been identified by CBP jurisdictions to achieve this goal, including the attainment of water quality in shallow-water bay grass designated use areas. In the Chesapeake Watershed Agreement (June 2014), the SAV goal/outcome was adjusted to reflect a more reasonable timeframe. The outcome states: "Sustain and increase the habitat benefits of SAV in the Chesapeake Bay. Achieve and sustain the ultimate outcome of 185,000 acres of SAV bay-wide necessary for a restored Bay. Progress toward this ultimate outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025." In 2021, there were an estimated 67,470 acres of underwater grasses in the Chesapeake Bay, an increase of 7%. SAVs were mapped using 4 salinity zones, rather than geographic zones. The change to salinity zones better reflects SAV community types and species composition. For a more detailed description of current and historic status, go to: https://www.vims.edu/research/units/programs/sav/reports/2021/index.php
	10. CBP jurisdictions recognize the value of salt marsh-fringed habitats, and will promote the protection and restoration of marsh-fringed shorelines, creeks and coves.	Continue	Salt marsh habitats protect molting blue crabs, and support many other prey species. These areas are susceptible to shoreline development and should be protected.
Ecosystem strategy CBP jurisdictions will incorporate information on ecosystem processes relating to blue crabs as it becomes available, and will utilize the information to determine management actions as necessary.	11. Utilize the guidelines from the Fisheries Ecosystem Plan (FEP) to incorporate multi-species and ecosystem considerations into existing CBP fishery management plans.	2005 Continue 2014 Continue	An EBFM operational structure was facilitated through MSG, with a blue crab species team formed in late 2008. The team completed biological briefs on important blue crab issues. The recommendation from the group is to use the briefs when the Blue Crab FMP is revised. In 2014, the Chesapeake Bay Program developed the Chesapeake Watershed Agreement. The document includes two outcomes for blue crabs. A biannual work plan was developed for 2022/2023 to address the outcomes.
	12. As data becomes available on food web dynamics, adjust fishing mortality rates on the blue crab population to include predator and prey needs.	Continue	Blue crabs play an important role in the food web of the bay. They are prey for important species of finfish, and are predators on other species such as mollusks. Blue crabs play a key role in the trophic dynamics of the Bay, and are considered the foremost benthic consumer in the Bay food web.
	13. Evaluate the impact of non-native crab introductions on the blue crab population, and develop recommendations accordingly.	Continue	There is concern over the interaction of blue crabs with non-native species of crabs, which include the green, mitten and Japanese shore crab. In 2006, MD adopted regulations that prohibit the transport of green or Japanese

			crabs. MD also adopted regulations to prohibit the import, transport, purchase, possession, sale or release of mitten crabs. The states have implemented education and outreach programs to highlight the problems associated with invasive species. In 2016, MD DNR developed the Maryland Aquatic Nuisance Species Management Plan.

Acronyms

BRP – biological reference points
CBSAC – Chesapeake Bay Stock Assessment Committee
CBP – Chesapeake Bay Program
CBBC FMP – Blue Crab Fishery Management Plan
EBFM – Ecosystem based fisheries management
F – Fishing mortality
FEP – Fisheries Ecosystem Plan
FMP – Fishery Management Plan
LCC – Limited Crab Catcher
MD DNR – Maryland Department of Natural Resources
MSG – Maryland Sea Grant
NRP – Natural Resource Police
SAV – Submerged Aquatic Vegetation
VMRC – Virginia Marine Resource Commission
WDS – Winter Dredge Survey

2021 Maryland FMP Report (December 2022)
Section 8. Bluefish (*Pomatomus saltatrix*)

The Mid-Atlantic Fishery Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission (ASMFC) have recommended approval of the Bluefish Allocation and Rebuilding Plan Amendment. The Amendment will establish a stock rebuilding plan, revise coastal states' commercial allocations, and revise the allocation between the commercial and recreational sectors. Development of the Amendment is ongoing.

The most recent operational stock assessment of the coastal bluefish stock was conducted in 2019. Based on data through 2018, the bluefish stock is overfished, but not currently experiencing overfishing. Changes to the Marine Recreational Information Program (MRIP) resulted in increased estimates of recreational fishing effort and catch, which led to the change in overfished status from the 2015 assessment. The next stock assessment is scheduled for 2022.

Bluefish support important commercial and recreational fisheries, but are sought after by recreational anglers more for sport than as table fare. They are a migratory, schooling species found throughout the world's coastal waters, except for the eastern Pacific. Bluefish are known for their aggressive feeding behavior and powerful fight when hooked, which often provides an exciting fishing experience.

On the Atlantic coast of the United States, bluefish undertake extensive seasonal migrations from Florida to Maine. Spawning occurs at sea, as the fish migrate northward beginning in spring. Young fish utilize nearshore waters and estuaries such as the Chesapeake Bay as nursery areas, where they prey voraciously on smaller fish and grow quickly.

Fishery Management Plans (FMPs)

The Chesapeake Bay Bluefish Fishery Management Plan (CBB FMP) was adopted in 1990 and amended in 2003. The CBB FMP Amendment 1 adopted the MAFMC and the ASMFC coastal overfishing definition and rebuilding schedule. The CBB FMP focuses on monitoring stock status and the fishery. The amendment added habitat protection and predator/prey considerations.

The 1989 ASMFC/MAFMC FMP was initially developed to address the concerns raised by recreational fishermen about harvest by the tuna purse seine fisheries. The coastal bluefish FMP was the first FMP to be developed jointly by an interstate commission and regional fishery management council. This plan has been amended seven times (1998, 2002, 2007, 2011, 2014, 2015 and 2017). The MAFMC/ASMFC FMP was first amended by ASMFC in 1998 to prevent recruitment overfishing, reduce fishing waste, improve cooperative management among states, maximize availability, and improve biological understanding of the species. Addendum I to Amendment 1 (2012) mandated increased collection of length at age data by states responsible for 5% or more of the coastal harvest; Maryland is exempt from the mandate.[1]

Currently under development is an amendment which will review the allocations of quota and transfers of quotas between states. The evaluation will also consider the need for management responses to shifting distributions and changes in social and economic drivers.

Maryland is required to submit an annual compliance report to ASMFC. The compliance report describes fishery dependent and independent monitoring, current regulations, commercial and recreational landings, and planned management actions.

Stock Status

Bluefish are managed as a single coastal stock. A benchmark stock assessment (SA) completed in 2015 improved on shortcomings of the previous SA and projected stock status through 2018. An update completed in 2019 included revised data through 2018. Catch estimates and juvenile recruitment indices were incorporated into the age-structured assessment program model to produce estimates of fishing mortality (F) and spawning stock biomass (SSB).[2]

The 2019 SA determined that bluefish are overfished: SSB in 2018 (201 million lbs) was below the SSB threshold (219 million lbs). Overfishing is not occurring; F in 2018 (0.146) was below the threshold of 0.183. As a result of new methods for estimating recreational catch, the SA found that overfishing had been occurring from 1985-2017. Spawning stock biomass has decreased over the past decade. Low catches in 2018 resulted in the lowest estimate of F since 1985.[3]

Current Management Measures

Annual stock assessment updates are used to determine total allowable landings (TAL) for commercial and recreational fisheries. Seventeen percent of the TAL is allocated to the commercial fishery, and the other 83% is allocated to the recreational fishery. The FMP allows for a portion of unused recreational TAL to be transferred to the commercial sector. The commercial fishery is managed under state-specific quotas, with allocations based on historical landings data from 1987-1989. The 2019 Atlantic coast recreational harvest limit (RHL) was 11.62 million lbs, and the coastal commercial quota was 7.71 million lbs. The 2020 Atlantic coast RHL was 9.48 million lbs and the coastal commercial quota was 2.77 million lbs. Recreational

landings were projected to reach the RHL in 2020 so a transfer from the recreational sector to the commercial sector was not allowed, resulting in a significant decrease to coastal commercial quotas. Maryland receives 3% of the coastal commercial quota, resulting in a 2020 quota of 83,054 lbs.[4]

The Fisheries

Maryland's commercial and recreational bluefish fisheries are open year-round, with a minimum size limit of 8 inches. The recreational fishery has had a daily limit of three fish per person per day for anglers fishing from shore or private boats, and five fish per person per day for anglers on for-hire boats.

Maryland's commercial bluefish harvest has decreased every year since 2015. Commercial harvest in 2020 was 20,786 lbs, a 9% decrease from 2019 (Figure 1). Approximately 61% of the commercial catch was harvested from the Chesapeake Bay and the remainder from Maryland's coastal waters.[5]

The Marine Recreational Information Program (MRIP) harvest estimate (A+B1) for 2020 was 173,846 fish (214,991 lbs) in Maryland, a 56% increase compared to 2019 (Figure 2). Live discards (B2) increased by 41%, from 226,968 fish in 2019 to 320,368 fish in 2020 (Figure 2).[6]

Monitoring Programs

Bluefish data is collected by the Maryland Department of Natural Resources (MD DNR) Chesapeake Bay Finfish Program and the Coastal Bays Program. Bluefish are sampled from pound nets to assess the size and structure of resident bluefish. Bluefish sampled in 2020 averaged 361 mm (14.2 inches) total length (TL), similar to 2019. Seine surveys are conducted in the Chesapeake Bay and the Atlantic Coastal Bays to develop bluefish juvenile indices. The 2020 Chesapeake Bay bluefish juvenile index was 0.04, similar to the 2019 index and below the time-series average of 0.2. The 2020 Coastal Bays bluefish juvenile index of 0.05 was the lowest value of the time-series.[5]

The Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) (2002-present) is designed to maximize the collection of biological and ecological data from important finfish species, and is implemented by the Virginia Institute of Marine Science (VIMS). Bluefish stomachs have been collected from this survey to evaluate food habits. Bluefish are predominantly piscivorous and consume bay anchovy, spot, menhaden, silver perch, weakfish, and mysid shrimp.[2]

Issues/Concerns

When developing 2020 management measures, recreational landings were predicted to exceed allowable recreational harvest limits. This predicted level of landings precludes a transfer of quota from the recreational to the commercial sector.

The MAFMC Bluefish Monitoring Committee developed new management measures to prevent an overage in recreational landings. A coastwide daily bag limit of three fish for private anglers or five fish for anglers on for-hire boats was implemented by public notice in Maryland for 2020.[3,5] The coastal RHL was still exceeded by 4.1 million lbs, but harvest estimation was complicated by COVID-19 shutdowns. Data imputation was used in months when in-person angler interviews were not conducted.[3] These imputations may mask the effects of the new regulations that were designed to constrain harvest.

The 2015 benchmark SA included more robust age data from multiple east coast states as required by Addendum I to Amendment 1.[1,2] Age-0 bluefish have a bi-modal (spring and summer) recruitment pattern. The contribution of recruits from each season to the adult population is uncertain, although it has been hypothesized that the spring cohort has a greater influence on adult abundance.[2]

The 2015 SA combined young of year indices from 6 states (NH, RI, NY, NJ, MD, VA) into a single composite index to reflect coastal recruitment patterns. Recreational discard mortality is an important factor for bluefish stock assessments, but data are limited.

The ASMFC Bluefish Technical Committee conducted a thorough review of bluefish discard mortality literature for the latest stock assessment, and approved an estimate of 15% for use in modeling. More information is needed about the sizes of fish released by recreational anglers. Commercial discard mortality is uncertain, though commercial discards are considered negligible.[2] The MAFMC Advisory Panel suggested using single hook gear in the recreational bluefish fishery, to reduce hooking damage for fish that are hooked and released. States should consider additional educational and outreach materials on how to avoid recreational hooking damage.

Figure 1. Maryland commercial bluefish landings and quota, 1950-2020.[5]

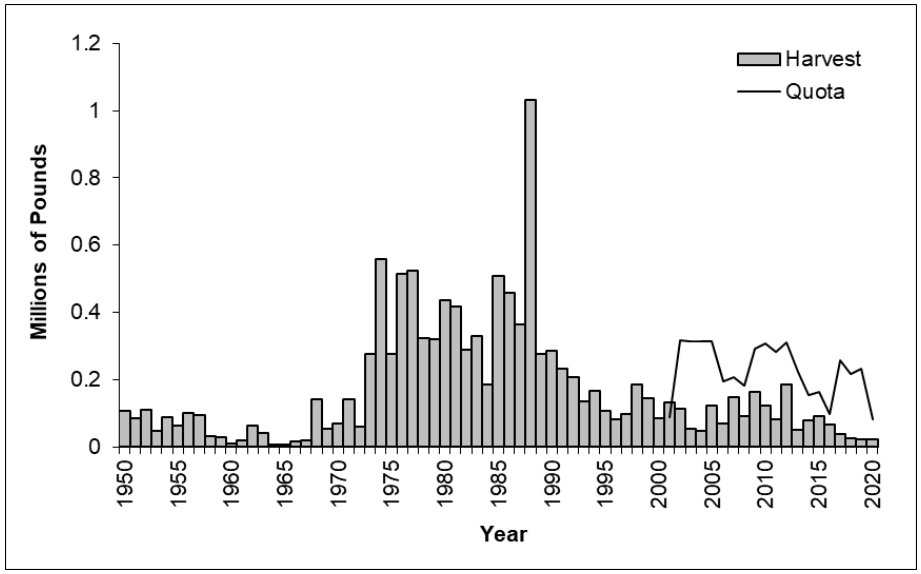
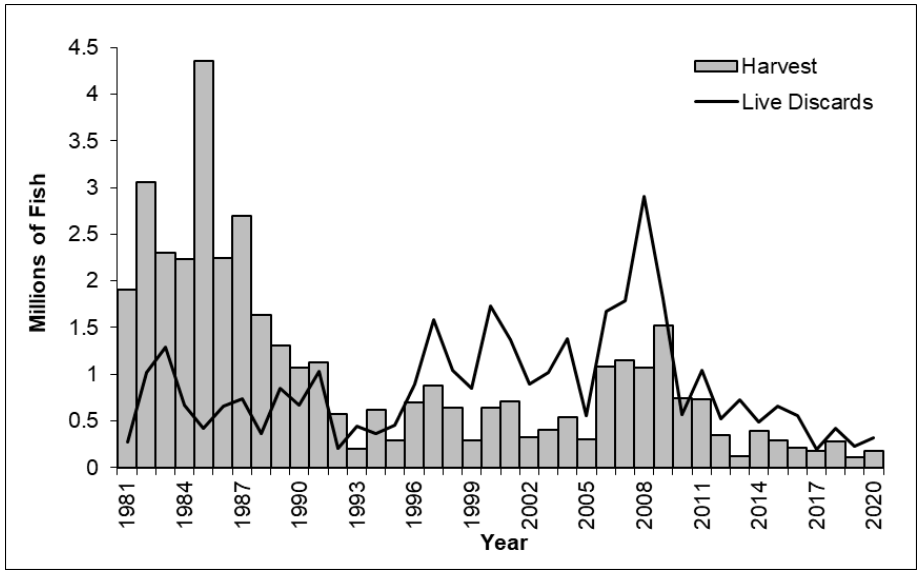


Figure 2. Estimated number of bluefish harvested and live discards by the recreational fishery in Maryland, 1981-2020.[6]



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[2] Atlantic States Marine Fisheries Commission. 2015. Bluefish Benchmark Stock Assessment for 2015. Atlantic States Marine Fisheries Commission, Alexandria, VA.

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[4] Fisheries of the Northeastern United States; Atlantic Bluefish Fishery; Revised 2020 and Projected 2021 Specifications and Recreational Management Measures. Federal Register, Vol. 85, No. 91. May 11, 2020. pp. 27703-27707.

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[6] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. April 21, 2021 query.

2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table			
Problem Area	**Action**	**Date**	**Comments**
Stock Status **Management Strategy** Management measures for the bluefish stock in the Chesapeake Bay will be based on the most recent coastal stock assessment. As stock assessment data, specific to the bluefish resources in the Bay, becomes available, additional measures will be developed. Management actions in Amendment #1 of the 1990 CBP Bluefish FMP will gradually rebuild the bluefish stock in the Chesapeake Bay and its tributaries over a 9-year period by reducing F and increasing SSB.	1.0**.** CBP jurisdictions will continue to participate in scientific and technical meetings for managing bluefish along the coast and estuarine waters.	1999 Continue	MD and VA staff participate on technical and advisory committees for both MAFMC and ASMFC.
	Action 1.1 CBP jurisdictions will adopt the MAFMC/ASMFC overfishing definition, and adhere to the 9-year rebuilding schedule for the coast wide management of bluefish: F=0.51 (1999-2000) F=0.41 (2001-2003) F=0.31 (2004-2007).	1999 Continue 2008 2015 2020	The 9-year rebuilding schedule reduced F: F=0.51(1999-2000) F=0.41(2001-2003) F=0.31(2004-2007) The bluefish stock is rebuilt, and overfishing is not occurring. Fishing mortality target is F_{MSY} = 0.170 and most recent F estimate is 0.157, below the target. Stock is overfished, but overfishing is not occurring. Rebuilding plan is in development.
Fishery Management Strategy CBP jurisdictions will follow the coastal management measures established by the ASMFC and the MAFMC, and coordinate fishery management measures within the Chesapeake Bay.	**Action 2.0** CBP jurisdictions will adhere to the commercial TAL established by the MAFM/ASMFC. Individual state-by-state TALs are based on historic landings from 1981-1989.	Continue 2020	The National Marine Fisheries Service (NMFS) established an initial 2019 coastal commercial quota of 7.71 million lbs and a coastal RHL of 11.62 million lbs. Maryland receives 3% of the commercial quota for a total of 231,426 lbs. VA receives 11.88% or 915,857 lbs. NMFS established a 2020 coastal commercial quota of 2.77 million lbs and a coastal RHL of 9.48 million lbs. Maryland receives 3% of the commercial quota for a total of 83,054 lbs.
	Action 2.1 CBP jurisdictions will continue to require licenses for harvest and sale of bluefish.	1991 Continue	Commercial licenses are required by each jurisdiction. VA requires an additional permit for commercial hook and line through a limited entry system. In VA, any species not managed under a coastal quota system is subject to the corresponding recreational creel limit for that species in the commercial hook and line fishery.
	Action 2.2 CBP jurisdictions will adhere to the coastal recreational harvest level established by the MAFMC/ASMFC. Virginia and the Potomac River Fisheries Commission (PRFC) instituted a 10 fish recreational creel limit in 1990.	1990 1991 Continue	Historically, recreational landings have accounted for 80-90% of the total catch. MD and the Potomac River Fisheries Commission (PRFC) have a 10-fish creel limit with an 8 inch minimum size limit. VA has a 10 fish creel, but no

	Maryland established a 10 fish recreational creel limit in 1991. Creel limits and minimum size limits may be modified, based on the annual TAL established for the Atlantic coast.	2020	minimum size limit. The coastwide RHL for 2018 was 15.12 million lbs and 2019 was 11.62 million lbs. New recreational regulations implemented by public notice in 2020. Anglers on for-hire boats may keep five fish per person per day. All other anglers may keep three fish per person per day. The minimum size limit of 8 inches remains in effect.
Research and Monitoring Strategy CBP jurisdictions will monitor the commercial and recreational fisheries, and improve catch and effort data. CBP jurisdictions will also pursue studies to evaluate the social and economic aspects of the bluefish fishery in the Chesapeake Bay.	Action 3.0 CBP jurisdictions will continue to collect catch and effort data from the commercial fishery, and expand the economic data to include dollar value of the commercial fishery, and the annual dockside value received for bluefish in CBP jurisdictions.	Continue Complete	Mandatory reporting is in effect in all CBP jurisdictions. Dockside value is available from NMFS. MAFMC created a Research Set Aside (RSA) program which allows up to 3% of the TAC to be sold, and the money used to fund research projects. The RSA program is currently suspended, pending thorough review of cost, benefit, and law enforcement concerns.
	Action 3.1 CBP jurisdictions will assess methods for improving recreational and charter catch/effort data needed to evaluate biological and economic impacts.	Continue 2011 Continue	MD requires logbooks for charter boats. Beginning in 2004, coastal species managed by quota are electronically reported in real time**.** The MRIP implemented a Chesapeake Bay and Coastal sport fishing license to provide a more comprehensive assessment of recreational fishing statistics than the Marine Recreational Fisheries Statistics Survey (MRFSS).
	Action 3.2 CBP jurisdictions will continue to collect fishery independent data on bluefish.	2001 Continue	The Chesapeake Bay Fishery Independent Multispecies Survey (ChesFIMS) and ChesMMAP surveys provided data used to help manage bluefish in Chesapeake Bay. The ChesFIMS survey ended in 2006. ChesMMap continues to provide data on diet preferences. Bluefish are regularly sampled by the MD DNR Fisheries Service to estimate recruitment and characterize size structure.
Habitat Management Strategy CBP jurisdictions will utilize the results from the new independent multifish surveys and research projects within the Chesapeake Bay, to identify and develop specific strategies to protect bluefish habitat and important forage species.	Action 4.0 CBP jurisdictions continue to set goals for water quality and habitat restoration and protection, to address commitments established under Chesapeake Bay 2000 Agreement.	2003 2009 2010	Bluefish habitat was identified in Amendment 1 to the Chesapeake Bay Bluefish FMP. President Barack Obama's executive order recommitted federal agencies to Bay restoration and regulatory enforcement. The Environmental Protection Agency established a Bay wide Total Maximum Daily Load (TMDL, aka:

			pollution diet). Each jurisdiction must establish 2 year milestones for progress towards meeting its TMDL. Legislation has been passed for restrictions on new developments using septic systems. Legislation for a stormwater fee based on impervious surface coverage was enacted. The Chesapeake Bay Program (CBP) monitors levels of mercury, PCBs, PAHs, organophosphate and organochloride pesticides. Ambient water quality criteria of DO, water clarity, and chlorophyll-a have been adopted for the Chesapeake Bay. See the CBP website for updates on water quality criteria https://www.chesapeakebay.net/issues https://www.chesapeakeprogress.com/clean-water https://www.chesapeakebay.net/files/FINAL-WQSAM-Post-Quarterly-Review-Logic-Action-Plan-2021.2022.pdf https://www.chesapeakebay.net/files/2020-2021_healthy_watersheds_logic_and_action_plan.pdf https://www.chesapeakebay.net/files/Toxic-Contaminants-Policy-and-Prevention-V3-2020-logic_and_action_plan.pdf https://www.chesapeakebay.net/files/2021-22-Toxic-Research-Logic-and-Action-Plan.pdf
	Action 4.1 CBP jurisdictions will regulate land and water activities that may negatively impact essential water quality parameters for bluefish, such as temperature, dissolved oxygen and turbidity.	Continue	The CBP continues to implement strategies to reduce nutrients and improve water quality in the Bay. Planting forest buffers, controlling stormwater runoff, and reducing agricultural and urban non-point nutrient inputs are part of the current action plan. MD developed the curriculum “Where Do We Grow from Here?” about population growth and its impacts on the Bay. See the CBP website for updates on land and water stewardship. https://www.chesapeakeprogress.com/conserved-lands

	Action 4.2 CBP jurisdictions will monitor activities that could negatively impact submerged aquatic vegetation in areas where bluefish have demonstrated a significant degree of association.	Continue 2003 Continue 2012 2014 Continue 1998 Continue	MD developed a Blue Infrastructure that includes mapping structural habitat and submerged aquatic vegetation (SAV). VIMS annually surveys SAV distribution in Chesapeake Bay. The SAV goal adopted by the Chesapeake Bay Program was planting 1,000 acres of SAV by 2008 and restoration of 185,000 acres of SAV by 2010. The planting goal was revised to 20 acres per year. A Chesapeake Watershed Agreement was adopted in June 2014, with interim targets of 90,000 acres by 2017 and 130,000 acres by 2025. **SAV coverage in 2020 was 62,169 acres.** https://www.chesapeakeprogress.com/abundant-life/sav https://www.chesapeakebay.net/files/2020-2021_sav_logic_and_action_plan.pdf Regulations are in place to prohibit dredging through SAV beds. Tiered designation and prioritization of SAV beds has not been implemented. Avoidance of dredging, filling and construction impacts to SAV, is strictly enforced by the Maryland Department of the Environment and the U.S. Army Corps of Engineers, with input from the MD DNR, The U.S. Fish and Wildlife Service, and NMFS. MD has not established undisturbed buffers. VA has established buffer criteria.
	Action 4.3 CBP jurisdictions will monitor important forage species, when identified by fishery independent surveys, to ensure that activities such as directed fisheries or incidental by-catch in non-directed fisheries, do not adversely affect forage species abundance. If fishing activities are contributing to higher fishing mortality (F) of important managed forage species such as Atlantic menhaden, Atlantic croaker, spot and/or blue crab, additional management measures may be necessary.	Continue 2012	Fish collected from ChesFIMS & ChesMAPP surveys provided stomachs for predator/prey analyses of juvenile and adult bluefish in the Chesapeake Bay. Variability of the abundance of forage fish in the Chesapeake Bay is aso being examined by an independent research project out of the Chesapeake Biological Laboratory (CBL). The ChesFIMs was discontinued after 2005 because of lack of funding. ASMFC determined that menhaden are overfished and that F needs to be reduced. The coastwide TAC is a 20% reduction from the average harvest during 2009-2011. Virginia is allocating 85% of the TAC

			while Maryland and PRFC are allocating 1.4% and 0.62%, respectively. Implementation began in 2013.
		2014	Results of the most recent stock assessment for menhaden, which considered new data, indicate that menhaden are not overfished and overfishing is not occurring.
		2015	The 2014 Chesapeake Watershed Agreement delineated a forage fish outcome, and a forage workshop was held in Nov. 2014. During 2015, a forage work plan was developed for 2016/2017.
		2017	The forage work plan was updated for 2018-2019 during 2017. https://www.chesapeakebay.net/files/documents/2018-2019_Forage_Fish_Outcome_Workplan_Final.pdf
	Action 4.4 CBP jurisdictions will monitor the abundance of important bluefish forage species that are not managed under CBP FMPs, such as bay anchovies and Atlantic silversides	Continue	The MD and VA juvenile seine surveys monitor the abundance of anchovies and silversides. Non- managed forage fish abundance is examined by an independent, CBL research project.
	Action 4.5 CBP jurisdictions will continue to identify predator/prey interactions, both inter- and intra-species competition, and other interactions that might affect the management of bluefish.	Continue	Data from the ChesFIMS and the ChesMAP surveys will be utilized to identify and delineate ecological relationships. Development of multispecies fishery management plans may result from this data.
		2012	A multispecies predator/prey model is being developed by ASMFC that includes bluefish, menhaden, striped bass, and weakfish.

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (11/2020)			
Strategy	**Action**	**Date**	**Comments**
1 – Stock Status and Increased Fishing Pressure: In order to protect the bluefish resource in the Chesapeake Bay and along the Atlantic coast from overexploitation, stock levels and fishing rates need to be monitored. Appropriate management actions may be needed if stock levels continue to decline, and harvest levels continue to increase.			
1.1.1) Since bluefish are a highly migratory species harvested along the Atlantic coast, Maryland, the Potomac River Fisheries Commission, and Virginia will cooperate with the Mid-Atlantic Fishery Management Council and the Atlantic States Marine Fisheries Commission to solve interjurisdictional problems in managing the bluefish stock	1.1.1) Maryland, the Potomac River Fisheries Commission, and Virginia will continue to participate in scientific and technical meetings for managing bluefish along the Atlantic coast and in estuarine waters.	Continue	Jurisdictions will work closely with MAFMC, ASMFC, and other coastal states, especially to monitor the commercial catch. See Amendment #1 Action 1.0
1.1.2) Maryland, the Potomac River Fisheries Commission, and Virginia will monitor the bluefish fisheries in the Chesapeake Bay and in state coastal waters, and implement conservation management measures for the fisheries as needed.	1.1.2.1) Maryland, the Potomac River Fisheries Commission, and Virginia will adhere to state allocations established by the MAFMC and ASMFC if the commercial harvest is projected to equal or exceed 20% of the total bluefish catch from the Atlantic coast. Commercial harvest controls will be coordinated among Bay jurisdictions, and will be consistent with those established in federal waters. Options may include gear restrictions, areal closures, trip limits, and quotas.	Dependent on harvest trends	Bay jurisdictions will coordinate with each other, and with the federal government. May include gear, trip, area, catch, and/or other restrictions. See Amendment #1 Action 2.0
	1.1.2.2) A) Maryland, Potomac River Fisheries Commission, and Virginia will continue current licensing requirements for the commercial harvest and sale of bluefish. B) Virginia will institute a 10 fish creel limit for the commercial harvest of bluefish by hook and line, and work towards establishing a commercial hook and line license.	1991	VA will require new regulations for commercial hook and line fishery. A) See Amendment #1 Action 2.1 B) See Amendment #1 Action 2.2
	1.1.2.3) Maryland will establish a 10 fish per person, per day, recreational creel limit for the Chesapeake Bay and state coastal waters. The Virginia and the Potomac River Fisheries Commission established a 10 fish per person, per day, recreational limit in summer 1990.	1991	Will require new regulations. Jurisdictions will coordinate creel limits and size limits. See Amendment #1 Action 2.2

	Upon receiving recommendation from the MAFMC and ASMFC, or as otherwise determined to be appropriate, jurisdictions may modify the possession limit and/or minimum size limit.		
2 – Wasteful Harvest Practices: There will be a baywide effort to eliminate, and/or minimize, wasteful harvest practices in the bluefish commercial and recreational fisheries.			
2.1) Efforts will be made to reduce the discard of dead bluefish in the Chesapeake Bay.	2.1.1) Virginia and the Potomac River established a 10 fish per person, per day, recreational creel limit, and Maryland will establish a 10 fish creel limit to minimize wastage (see Action 1.1.2.3).	1991	See Action 1.1.2.2 See Amendment #1 Action 2.2
	2.1.2) Maryland, the Potomac River Fisheries Commission, and Virginia will educate the general public, through the use of information brochures and other means, about the need to reduce the waste problem in the bluefish fishery. Hook and release will be promoted as one method for reducing waste in the fishery.	1991	MD has produced a video & fact sheet on hook & release; ASMFC has also developed a hook & release brochure. Will explore other means to educate the public about reducing waste.
	2.1.3) Maryland, the Potomac River Fisheries Commission, and Virginia will begin assessing factors contributing to waste in the commercial bluefish fishery and identifying potential solutions. Issues to be considered include migratory patterns of bluefish, bycatch, the bait fishery, and market demand.	1991	Waste associated with the commercial fishery is no longer an issue.
3 – Research and Monitoring Needs: In order to increase the knowledge and understanding of the bluefish fishery in the Chesapeake Bay, the jurisdictions will monitor the commercial and recreational fishery, and improve catch and effort data. The jurisdictions will also pursue studies to evaluate the economic aspects of the bluefish fishery.			
3.1) Maryland, the Potomac River Fisheries Commission, and Virginia will increase the knowledge and understanding of the bluefish fishery in the Chesapeake Bay.	3.1.1) Maryland, the Potomac River Fisheries Commission, and Virginia will improve the catch and effort data collected from the bluefish commercial fishery in the Chesapeake Bay. Recommendations for improving the system include:	1991	Will be accomplished in conjunction with other fish species reporting. Need to assess licensing, reporting, and follow up systems. VA will pursue a mandatory reporting system. See Amendment #1 Action 3.0

	1) Coordinate finfish license requirements with the needs of finfish catch and effort reports. 2) Reevaluate the reporting form to include information on what types of gear a fisherman owns, how much they used on a particular day, and how much they caught. 3) Develop a check and balance system to validate the catch and effort records. 4) Continue the commercial reporting requirements in Maryland, and establish a mandatory reporting system in Virginia. 5) Evaluate how the use of young bluefish in the bait fishery contributes to fishing mortality.		
	3.1.2 Maryland, the Potomac River Fisheries Commission, and Virginia will assess methods for improving recreational/charter catch and effort data needed to evaluate the biological and economic impacts of these fisheries. Recommendations include: 1) Evaluate hook and line data collected from the Maryland charter boat industry, i.e., age and length frequency, to characterize the recreational catch in the Bay. 2) Obtain economic information for the recreational and charter fisheries to determine the factors important for sustaining these industries and determining their value to the region. 3) Institute a pilot survey of sportsfishermen. 4) Institute a pilot survey of sportsfishermen in Maryland to obtain catch and effort data for several species, including bluefish.	1991	ASMFC is encouraging states to buy into MRFSS for bluefish; Bay jurisdictions will assess feasibility. Need staff to look at existing biological data and assess economic factors. See Amendment #1 Action 3.1
	3.1.3) Maryland, the Potomac River Fisheries Commission, and Virginia will encourage research to collect data on bluefish biology, especially estimates of population abundance, mortality, and recruitment in the Chesapeake Bay. Suggested research topics include: 1) Determine the factors that affect bluefish movements and distribution in the Bay.	1991	Will coordinate with the Chesapeake Bay Stock Assessment Committee, universities, and other agencies. See Amendment #1 Action 3.2

	2) Collect data on length frequency and age composition of both the commercial and recreational bluefish catch. 3) Investigate the environmental parameters that affect reproduction and growth of bluefish.		
4 – Habitat Issues) Adequate water quality is necessary to insure the protection of living resources in the Chesapeake Bay. The jurisdictions will continue their efforts to improve water quality and define habitat requirements for the living resources in the Chesapeake Bay.			
4.1) The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to promote the commitments of the 1987 Chesapeake Bay Agreement. The achievement of the Bay commitments will lead to improved water quality and enhanced biological production.	4.1) The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to set specific objectives for water quality goals, and review management programs established under the 1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement Call for: 1) Developing habitat requirements and water quality goals for various finfish species. 2) Developing and adopting basinwide nutrient reduction strategies. 3) Developing and adopting basinwide plans for the reduction and control of toxic substances. 4) Developing and adopting basinwide management measures for conventional pollutants entering the Bay, from point and non-point sources. 5) Quantifying the impacts, and identifying the sources of atmospheric inputs, on the Bay system. 6) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation. 7) Managing population growth to minimize adverse impacts to the Bay environment.	Continue	Agencies must coordinate closely; must continue to work on habitat requirements for bluefish and other water quality issues in the Chesapeake Bay. The CBP develops, revises, and monitors goals and strategies for agriculture, air pollution, bay grasses, chemical contaminants, climate change, development, education, forests, groundwater, nutrients, population growth, rivers and streams, sediment, stormwater runoff, wastewater, weather, and wetlands. For more information: https://www.chesapeakebay.net/issues See Amendment #1 Actions 4.0, 4.1, 4.2

Acronyms

ASMFC – Atlantic States Marine Fisheries Commission
B_{msy} – Biomass maximum sustainable yield
CBB – FMP Chesapeake Bay Bluefish FMP
CBL – Chesapeake Biological Laboratory
CBP – Chesapeake Bay Program
ChesFIMS – Chesapeake Bay Fishery Independent Multispecies Survey
ChesMAP – Chesapeake Bay Multispecies Monitoring & Assessment Program
DO – Dissolved Oxygen
F – Fishing Mortality
FMP – Fishery Management Plan
F_{msy} – Fishing mortality maximum sustainable yield (MSY).
MAFMC – Mid-Atlantic Fishery Management Council
MD – Maryland
MD DNR – Maryland Department of Natural Resources
MRFSS – Marine Recreational Fisheries Statistics Survey
MRIP – Marine Recreational Information Program
NMFS – National Marine Fisheries Service
PAH – Polycyclic Aromatic Hydrocarbon
PCB – Polychlorinated biphenyl
PRFC – Potomac River Fisheries Commission
RHL – Recreational Harvest Limit
RSA – Research Set-Aside
SA – Stock Assessment
SAV – Submerged Aquatic Vegetation
SSB – Spawning Stock Biomass
TAC – Total Allowable Catch
TAL – Total Allowable Landings
TMDL – Total Maximum Daily Load
VA – Virginia
VIMS – Virginia Institute of Marine Science

2021 Maryland FMP Report (December 2022)
Section 9. Maryland Catfish Species

Introduction

There are three native catfish species endemic to Maryland's tidal Chesapeake Bay waters, brown bullhead (*Ameiurus nebulosus*), white catfish (*A. catus*) and yellow bullhead (*A. natalis*). Channel catfish (*Ictalurus punctatus*) are considered naturalized, meaning they were introduced, have long-established and sustaining populations, and have not unduly harmed native biota. Blue catfish (*I. furcatus*) and flathead catfish (*Pylodictis olivaris*) are considered invasive catfish which implies that they may pose a threat to the aquatic ecosystem. Blue catfish have colonized most areas of Maryland's Chesapeake Bay watershed. Blue catfish are opportunistic feeders, exerting predatory pressure on all trophic levels. This allows blue catfish to dominate local fauna in biologically short time-frames. Flathead catfish introgression is more limited spatially. Flathead catfish are apex predators in the ecosystem, which raises concerns about their effects on native fish communities.

Channel catfish, blue catfish, and flathead catfish are particularly popular with recreational fishermen. The National Oceanic and Atmospheric Administration estimated that there were 117,000 recreational fishing trips targeting blue catfish and 228,000 trips targeting channel catfish in the Chesapeake Bay during 2021. Blue catfish, channel catfish, and flathead catfish provide a challenge for recreational fishermen and attain relatively large sizes with average catch weights in the range of 4 to 15 pounds per fish. State record catfish are currently 29.6 lbs for channel catfish, 84 lbs for blue catfish, and 57 lbs for flathead catfish. Recreational anglers harvested 3.6 million lbs of catfish (species combined) in 2021, accounting for 32% of the entire statewide recreational finfish harvest. The catfish species recreational harvest was the largest of all species in 2021 (3.6 million lbs compared to 2.7 million lbs of striped bass harvested in 2021). The channel catfish fishery has been a stable and profitable commercial fishery for decades. Peak commercial channel catfish landings occurred in 2012, and landings averaged 1.7 million pounds, annually, over the ten year period, 2012-2021. The blue catfish commercial fishery is increasing rapidly. Commercial landings increased 77% in 2021 compared to 2011, the first year watermen were required to list catfish harvest by species.

Controlling the spread and colonization of blue catfish and flathead catfish has become a multi-agency priority. The Sustainable Fisheries Goal Implementation Team (GIT) of the Chesapeake Bay Program developed a policy on invasive catfish species. The policy agrees to develop and implement management strategies to reduce invasive catfish populations and mitigate their spread. Maryland developed an Aquatic Nuisance Species Management Plan in 2016. Both blue catfish and flathead catfish were identified as high priority aquatic nuisance species. The high priority status is based on the "high potential of negative economic and/or ecological impacts."
http://dnr.maryland.gov/Invasives/Documents/Maryland_Aquatic_Nuisance_Species_Plan.pdf

The Maryland Department of Natural Resources embarked on developing a fishery management plan for catfish in 2020. The Fishery Management Plan for Tidewater Catfish was completed in December of 2021.

Stock Status

A population assessment of channel catfish was completed in 2010, and most recently updated with data through 2021.[2] Catch Survey Analyses (CSA) were utilized to assess population status in the upper Chesapeake Bay and separately in the Choptank River. Channel catfish status in the Potomac, Patuxent and Nanticoke rivers was determined from commercial landings.

Assessment results indicated that Choptank River channel catfish abundance (N) has been declining since 2015 (Figure 1). Estimates of instantaneous fishing mortality (F) of channel catfish in the Choptank River were low for a species with the life history of channel catfish during the entire time series (28 years; Figure 2). This suggests that recruitment failures over an extended period are the cause of the population decline.

The upper Chesapeake Bay CSA model (2005 –2021) indicated that the population increased near linearly from 2005 through 2019. Since 2019, the population declined slightly at levels approximately 50% higher than the time series median (Figure 3). Fishing mortality (F) was higher than the Choptank River (Figure 4), but recruitment was robust 2015-2021, which allowed for population growth in spite of higher F. Channel catfish stock status is less clearly defined in the Nanticoke, Patuxent, and Potomac rivers. Commercial landings indicated that channel catfish stocks are increasing in the Nanticoke River, stable in the Patuxent River, and at low levels in the Potomac River. The Potomac River channel catfish decline coincides with blue catfish expansion.

White catfish are not particularly important in the commercial fishery, due to low yield per fish. White catfish relative abundance in the Choptank River was above average 2016-2018, but below average in 2019-2021. Population relative abundance was slightly higher in 2021 compared to 2020 (Figure 5).[3] Catch per unit effort of white catfish in the upper Chesapeake Bay winter trawl survey declined from 2016-2019, but increased in 2020 and 2021 (Figure 6).[3] Relative abundance was above average in both years.

Blue catfish relative abundance in the upper Chesapeake Bay increased over the time series after the invasive species was first detected in the trawl survey in 2015 (Figure 7). Blue catfish population expansion, as indicated by commercial landings and other Department surveys, continued in most tidal river systems in Maryland.

Management

There are no minimum size limits, no creel limits, or closed seasons for any commercial or recreational catfish fisheries in tidal waters. Area and gear restrictions apply to commercial fishermen, but are not catfish-specific. In non-tidal waters (recreational harvest only), there is a 5 fish per person per day creel limit, with a 10-fish possession limit and no minimum size limit for channel catfish.

Given the popularity of catfish, their ecological role and potential negative impacts of invasive species, a draft Fisheries Management Plan was developed in 2020. The draft Plan provided action items to sustain native catfish and control the impacts of invasive catfish. During 2021, the plan development process progressed through the Department's Advisory panels.

Fishery Statistics

The catfish commercial fishery is important in the Chesapeake Bay region. Catfish are caught in commercial fish pots, fyke nets, and pound nets. They are sold in both "dead" and "live" markets. Commercial channel catfish harvest declined drastically in 2021 to 541,530 lbs, a decrease of 67% from 2019 (1.7 million lbs; Figure 8). Given the assessment results, it is likely that the decrease was due to decreased effort by commercial fishermen. The 2021 commercial harvest for blue catfish was 542,954 lbs (Figure 8). This is the first time that annual blue catfish harvest was greater than channel catfish harvest. The combined catfish complex accounted for 24% of the total finned food fish harvest in Maryland, Chesapeake Bay and Atlantic coastal bays and Ocean combined.

Recreational fishery statistics are estimated from the Marine Recreational Information Program (MRIP; National Oceanic and Atmospheric Administration)[8]. Blue catfish and channel catfish recreational harvest, combined, was usually below 1.0 million lbs 1983-2009 (Figure 9). Harvest then increased quite rapidly to a peak in 2014 at 4.2 million pounds. Harvest was near 3.5 million pounds in 2021. MRIP data also provide recreational effort. The survey estimated that there were 117,000 recreational fishing trips targeting blue catfish and 228,000 trips targeting channel catfish in the Chesapeake Bay during 2021.

In 2016, Maryland legislation expanded the types of gear that can be legally used for harvesting catfish. Maryland now allows trotlines for commercial fishermen who are targeting flathead catfish and blue catfish. The blue catfish harvest from the new trotline fishery was 178,000 lbs in 2019, 200,000 lbs in 2020 and 117,431 in 2021. Additionally, the trotline fishery landed 1,945 lbs of channel catfish. Legislation also expanded the use of haul seines to include the weekends. Blue catfish harvest from the haul seine fishery was 262,000 lbs in 2019, 118,000 lbs in 2020 and 168,310 lbs in 2021. Combined, the gear encompassed by the regulation changes removed one million pounds of the invasive blue catfish since 2019.

Issues of Concern

Introduced non-native blue and flathead catfish compete with native species for forage. Fishermen most likely have moved these invasive species to different areas within the Bay, in misguided attempts to "improve" fishing conditions. Declines of channel catfish biomass have corresponded to the appearance of the blue catfish in Potomac River surveys.[1] Blue catfish interspecific competition and predation may hinder channel catfish population recovery. Native white catfish have declined in many areas, and circumstantial evidence suggests their decline may be correlated to the expansion of non-native, invasive catfish species. This may also have consequences to the recoveries of ospreys and eagles that rely upon native and naturalized fish species for high quality forage.[4]

Tagging results from Virginia studies indicate that blue catfish can move both short and long distances within a river system. Their salinity tolerance is higher than most freshwater fishes, so they have the potential to expand to other rivers, depending on whether it is a dry or wet year. Larger blue catfish appear more tolerant of salinity than smaller blue catfish.

Diet studies by Maryland Department of Natural Resources (MD DNR) staff in the Potomac River revealed blue catfish regularly prey on herring, white perch, and yellow perch.[5] Other studies from Virginia waters indicated a relatively high occurrence of mollusks in blue catfish stomachs. This is of particular importance to Maryland drainages, given the efforts to restore native mussel (*Elliptio* spp.) populations.[6]

Catfish can occur throughout the year in degraded habitats. They accumulate toxins, especially PCBs and pesticides, and MDE has posted consumption advisories for many areas such as Baltimore Harbor, Middle River, Patapsco Harbor, and portions of the Anacostia River, Back River, Elk River, and Potomac River. In addition to the human health advisories, catfish found in some habitats, such as the Anacostia River, exhibit high rates of skin and liver tumors, likely a result of exposure to polynuclear aromatic hydrocarbons (PAHs) in contaminated sediments.[6,7]

The Chesapeake Bay jurisdictions have engaged in a public outreach effort to inform people about invasive catfish species. Maryland developed an awareness campaign to help people identify and catch invasive catfish, understand the importance of prohibiting their transport, and encouraging anglers to keep and not release them. Signage was posted at popular fishing access sites to inform the fishing public of the need to remove invasive catfish when caught.

Figure 1. Channel catfish abundance (N) from Choptank River population model, 1993–2021.

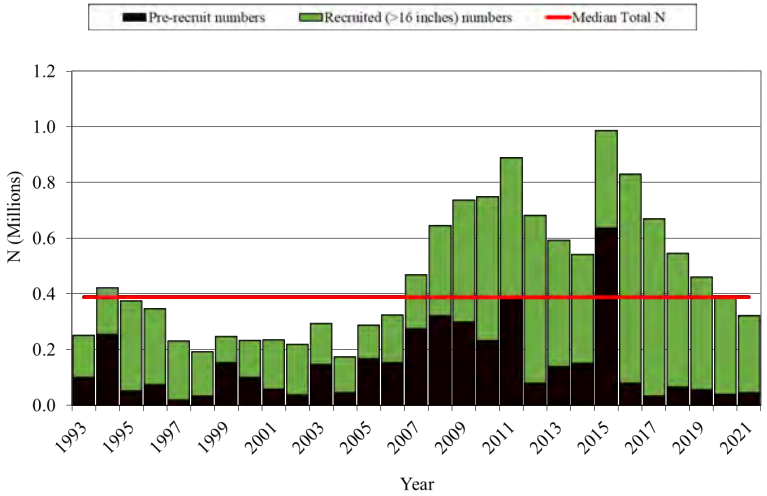


Figure 2. Channel catfish fishing mortality (F) from the Choptank River fyke net survey, 1993–2020.

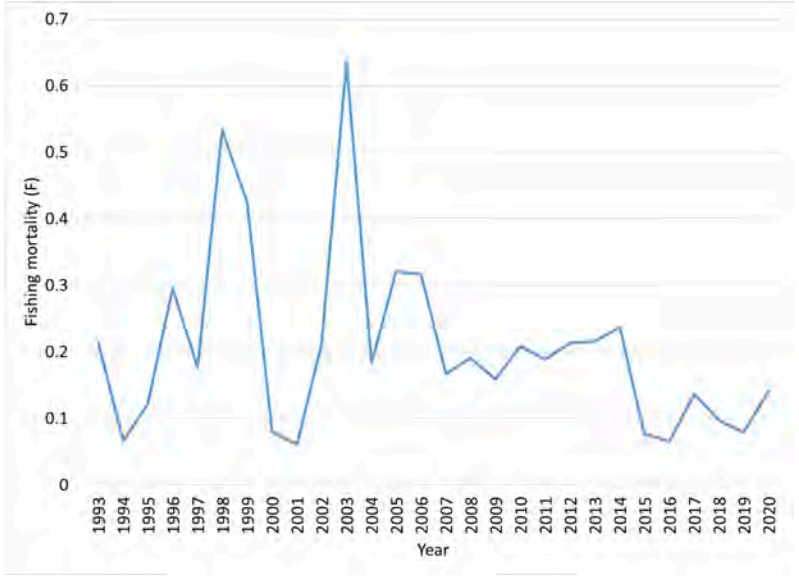


Figure 3. Channel catfish abundance (N) from the upper Chesapeake Bay population model, 2005–2021.

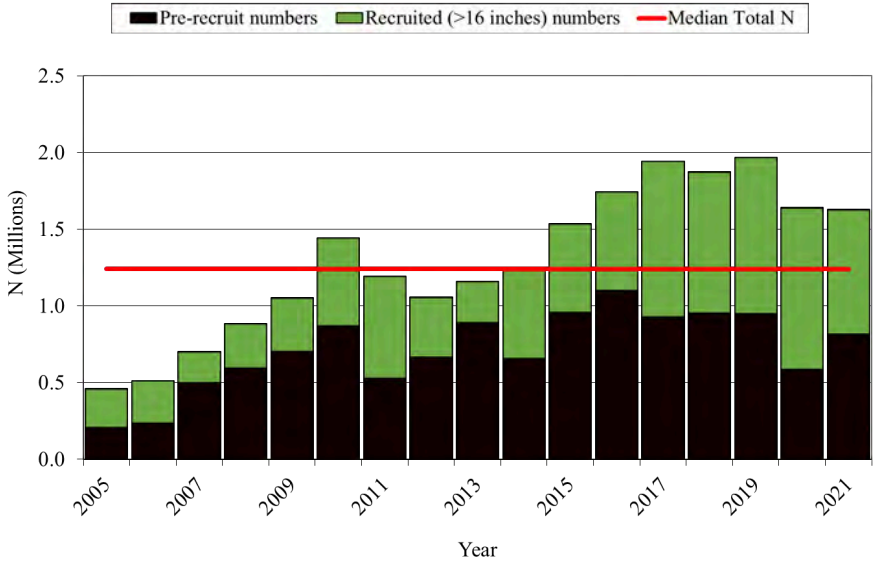


Figure 4. Upper Chesapeake Bay channel catfish fishing mortality (F) 2005–2020.

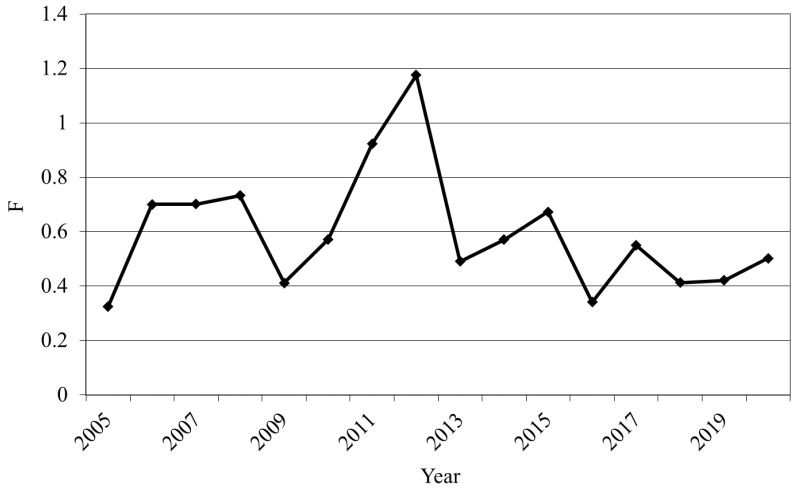


Figure 5. White catfish relative abundance in the Choptank River, 2000 – 2021.

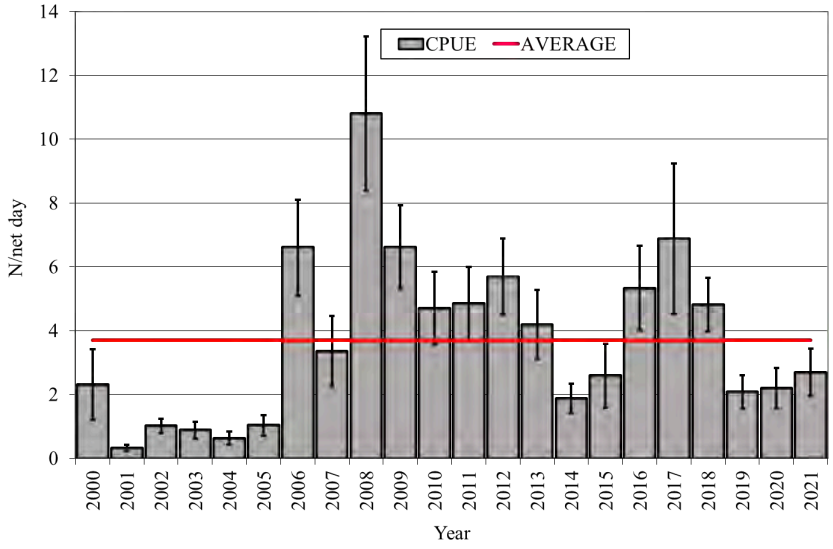


Figure 6. White catfish relative abundance from the upper Chesapeake Bay winter trawl survey, 2000 – 2021.

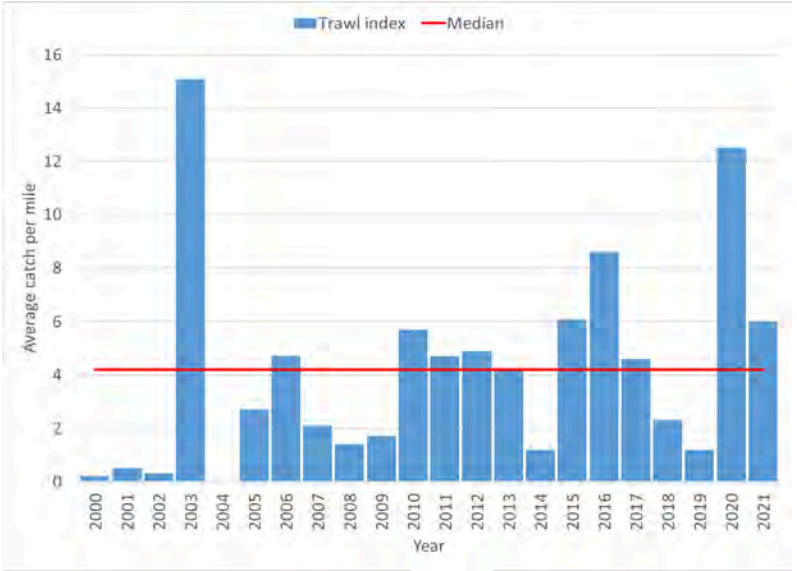


Figure 7. Blue catfish relative abundance from the upper Chesapeake Bay winter trawl survey 2000–2020.

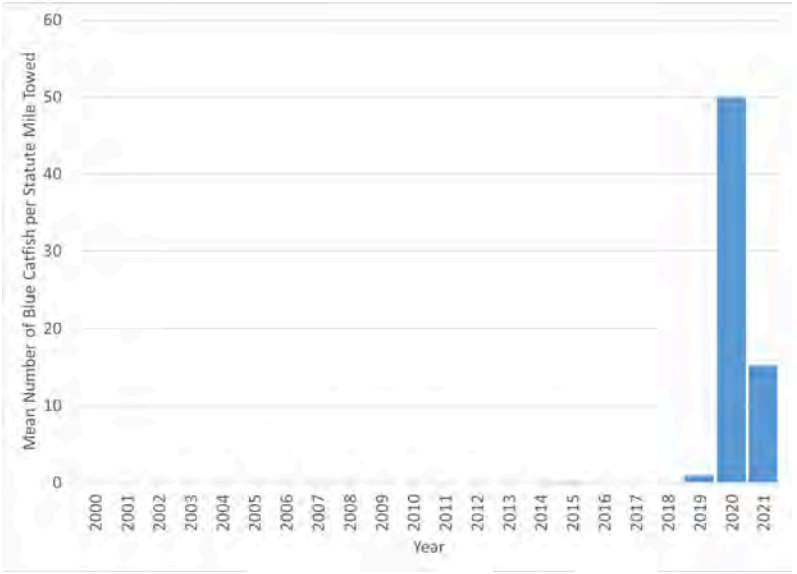


Figure 8. Catfish commercial landings, by species, 1996–2021 (MD DNR data).

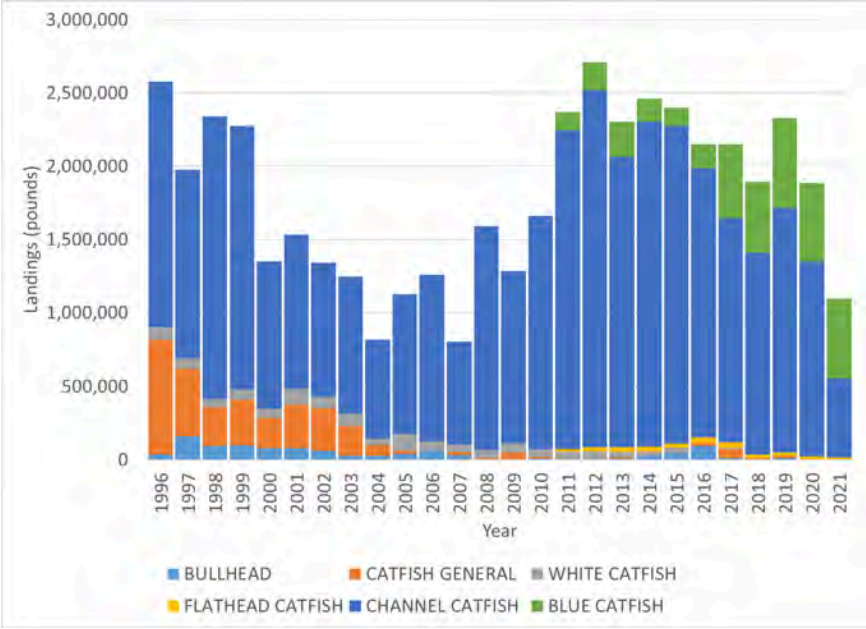
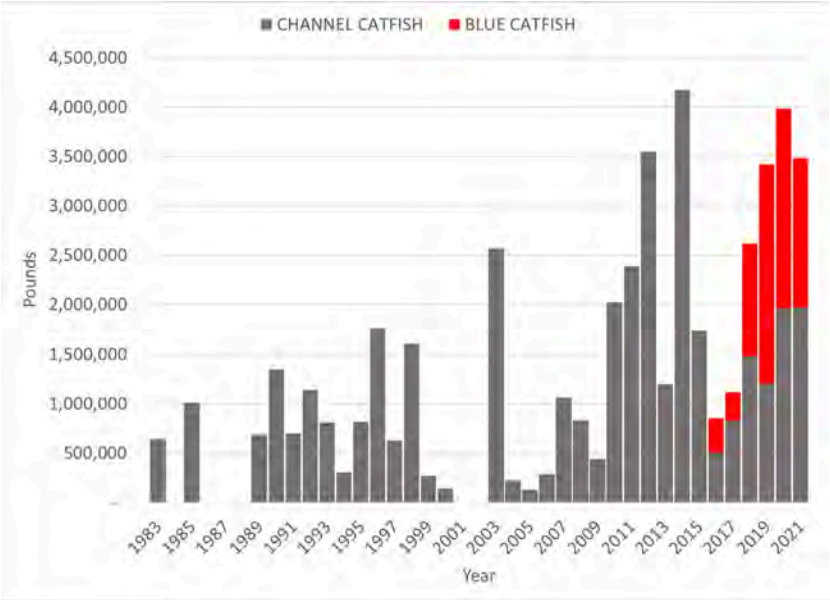


Figure 9. Recreational landings of channel catfish and blue catfish in Maryland, 1983 – 2021. Years without data indicate unsuitable estimation due to high variance.



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Section 10. Maryland Coastal Bays Blue Crab (*Callinectes sapidus)*

In Maryland, the Atlantic Coastal Bays and the Chesapeake Bay are separate diverse ecosystems that both maintain a unique blue crab population which are managed under different fishery management plans. The coastal blue crab fishery is managed under the 2001 Coastal Bays Blue Crab Fishery Management Plan (Coastal BCFMP) which identifies management measures to conserve the coastal blue crab population while protecting the ecological and socio-economic value of the species. During the last plan review the Coastal BCFMP was determined to still be an appropriate framework for managing the coastal blue crab fishery.

Fishery Management Plan (FMP)

Development of the 2001 Coastal BCFMP was triggered by the Comprehensive and Conservation Management Plan (CCMP); adopted for Maryland's Coastal Bays in 1999. The CCMP recommended that the Maryland Department of Natural Resources (MD DNR) address fishery issues specific to Maryland's Coastal Bays. To view the entire CCMP, go to the Maryland Coastal Bays National Estuary Program website at http://www.mdcoastalbays.org. The CCMP is reviewed and updated on a regular basis. A comprehensive review of the CCMP was completed during 2013 and resulted in updated goals, objectives, and actions. The plan was revised as the 2015-2025 Maryland Coastal Bays Comprehensive Conservation and Management Plan. The revised plan addresses water quality and the environmental health of estuaries around Ocean City and Assateague Island. The CCMP includes 4 additional plans, 15 goals, 33 challenges, and 222 actions. The status of the Coastal Bays is assessed through an environmental report card process. The combined 2019-2020 report card score for Maryland's Coastal Bays was C+. The 2019-2020 report card can be viewed at https://mdcoastalbays.org/app/uploads/2021/10/2021-maryland-coastal-bays-report-card.pdf

Stock Status

There is no area specific stock assessment for blue crabs in the Coastal Bays. The Coastal Fisheries Program samples blue crabs as part of its trawl and beach seine surveys. Catch-per-unit-effort (CPUE), calculated from both the trawl and beach seine surveys, indicate that the relative abundance of blue crabs has varied over time without any trends (Figures 1 and 2). The fishery independent indices and the relative stability of the commercial harvest indicate a stable population.

Recruitment of juveniles into the Coastal Bays is largely driven by environmental and hydrologic elements of the Atlantic Ocean. Although there is evidence that some internal recruitment is occurring, it is hypothesized that most of the juveniles that take up residence in Maryland's Coastal Bays are transported by ocean currents from the mouth of the Chesapeake and Delaware Bays. Changes in climate patterns could affect blue crab larval recruitment into the Coastal Bays.

Fishery Statistics

Maryland's Coastal Bays support both a commercial and recreational blue crab fishery. The preliminary 2021 commercial harvest of hard, soft, and peeler crabs from the Coastal Bays was 0.9 million lbs, similar to 2020 (Figure 3). Annual commercial harvest of blue crabs from the Coastal Bays has ranged from 0.54 to 2.4 million lbs, with an average harvest of 1.3 million lbs. Crab pots accounted for 91% of the total commercial harvest in 2021. The recreational fishery is primarily a small boat fishery due to limited public shoreline/pier/bulkhead access. Recreational harvest of blue crabs in the Coastal Bays is undocumented. Estimates of recreational harvest from the Chesapeake Bay are believed to be between 8% and 11% of the commercial harvest. Whether or not this estimate is applicable to the Coastal Bays is unknown.

MD DNR began implementing an electronic method of reporting blue crab harvest in the Chesapeake Bay in 2012. Providing timely and verifiable harvest data on a daily basis is the first step towards improving the blue crab management system. Watermen from the Coastal Bays have also been participating in the voluntary program.

Management Measures

MD DNR manages the Coastal Bays commercial blue crab fishery through daily catch limits (25 bushels per boat per day), seasons (closed from November 1 through March 31), daily time restrictions, gear restrictions (no scrapes or dredges), limited entry, and other management strategies as necessary to control fishing effort. MD DNR manages the recreational blue crab fishery in the Coastal Bays through daily catch limits (one bushel per person per day and no more than two bushels per boat per day), gear restrictions (no more than 600 feet of trotline per person or two 600 foot trotlines per boat; 10 collapsible traps or crab net rings per person or 25 traps or rings per boat), and seasons (closed from January 1 through March 31). No license is required. Waterfront property owners can use two crab pots off their dock/pier. The pots must be marked with the owner's name and address or MD DNR identification number, and must have 2 cull rings with required dimensions located in the exterior side panel or on the top panel of the pot. Landowners that use crab pots off their docks must also have a turtle excluder device attached to each entrance or funnel in

the lower chamber constructed of wire or plastic, rectangular in shape, and not larger than 1 ¾ inches high by 4 ¾ inches long. The excluder device is required to keep terrapins from drowning in pots. In both the commercial and recreational fisheries there are minimum size limits (minimum 5 inches for hard crabs, 3 ½ inches for soft crabs and time-period size differences for peeler crabs (3¼ inches prior to July 15th and 3½ inches after July 15th). There is no minimum size limit on mature female crabs, and the taking of sponge crabs is prohibited. Special regulations are in place for crabbing in Worcester County and may change annually (see the Code of Maryland Regulations (COMAR) for a complete list of restrictions).

Issues/Concerns

A parasitic dinoflagellate, *Hematodinium* sp., can cause mortality in blue crabs from the Coastal Bays. Studies conducted in 2005 and 2006 indicated that the number of infected crabs followed a seasonal pattern, increasing from late summer through December. Results indicated that salinity and water temperature are vital components for the proliferation of the parasite and associated mortality. The results of a paper published in 2018 indicated that the prevalence of parasitic infection in Maryland Coastal Bay blue crabs varied significantly by year.[1] Parasite prevalence and intensity typically peaked in summer. Juvenile crabs (<20 millimeters) were more susceptible to parasite infection in the fall, medium-sized crabs (61-90 millimeters) were more susceptible to initial infection in the spring, and crabs >60 millimeters were most likely to proliferate the parasite. There is still much that is unknown about *Hematodinium* sp. and its effects on the blue crab population in the Coastal Bays. The Virginia Institute of Marine Science (VIMS) and University of Maryland Eastern Shore (UMES) are currently studying the effects of *Hematodinium* on blue crabs.
https://www.google.com/url?q=https://www.vims.edu/research/units/programs/crustacean/research/hematodinium/eid_project/&sa=D&source=docs&ust=1746112807060875&usg=AOvVaw1bCoklvbsOG-zYzeBHkKJn

Viruses of all types have been documented in blue crabs, and it is likely that diseases can impact population dynamics. Recent advances in molecular and biotechnological tools have been utilized to assess the prevalence and intensity of diseases. More research is needed to quantify diseases' effects on abundance of crabs in the Chesapeake Bay and Coastal Bays.

Figure 1. Maryland blue crab seine CPUE from the Coastal Bays Fisheries Investigations, 1989-2021.

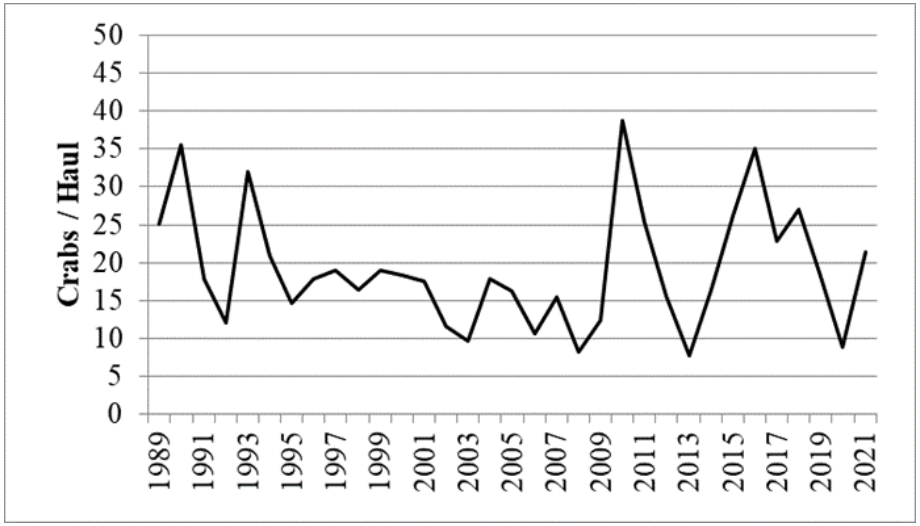


Figure 2. Maryland blue crab trawl CPUE from the Coastal Bays Fisheries Investigation, 1989-2021.

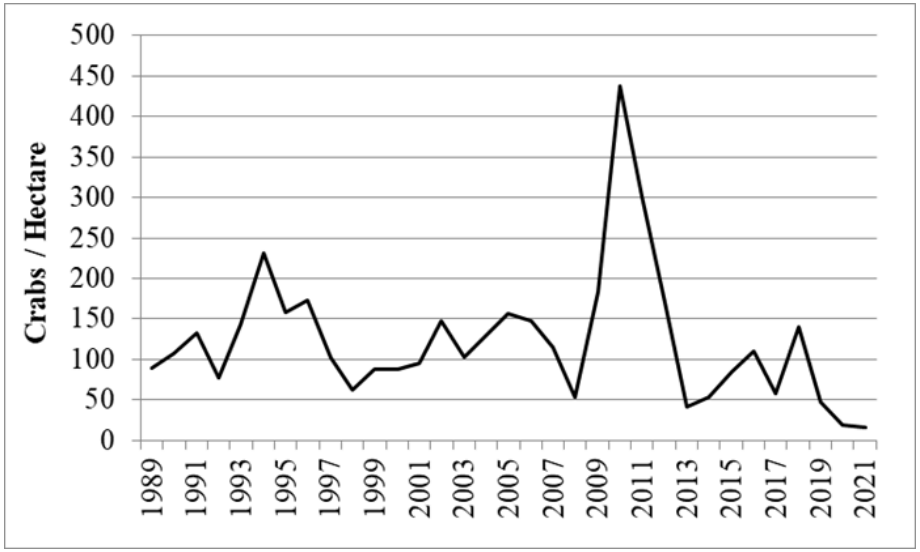
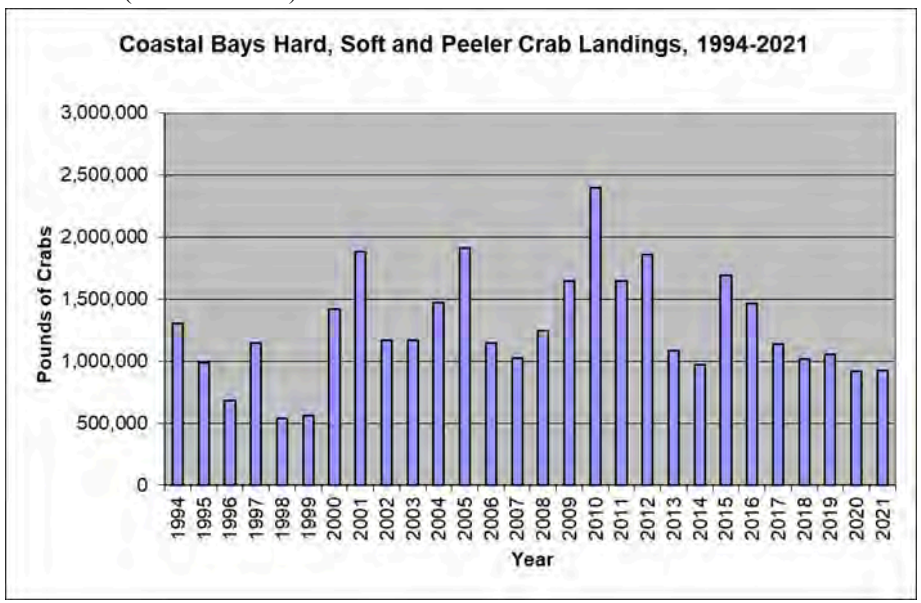


Figure 3. Total Maryland Coastal Bays Blue Crab commercial harvest in pounds, 1994-2021 (MD DNR data).



Reference

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2001 Coastal Bays Blue Crab Fishery Management Plan Implementation		
Objective/Problem	**Action**	**Implementation**
Obj. 1. Improve our understanding of how *Hematodinium* contributes to the mortality and population abundance of blue crabs. Prob. 1.1: Research and Monitoring.	**1.4.1.** DNR and MCBP will identify potential funding sources to support the following research and monitoring activities: a) Assess the impact of *Hematodinium* on the blue crab population in our Coastal Bays (i.e. identify what intensity of *Hematodinium* infection causes mortality, and identify other factors, environmental and/or biological, that may influence blue crab mortality from *Hematodinium*). b) Identify factors which influence *Hematodinium* proliferation, elucidating different life stages, determining the full life cycle of the parasite, and eventual production of a more specific diagnostic tool either by immunoassay or molecular assay techniques. c) Examine how crabs become infected with *Hematodinium*.	Research includes monitoring prevalence in MD coastal bays. Research is ongoing with the NOAA Oxford Cooperative, UMES, and VIMS. A 2010/2011 University of MD project found the presence of *Hematodinium* sp. in 9% of the water and sediment samples. Viruses of all types have been documented in blue crabs and likely impact population dynamics. VIMS is currently conducting a disease study on crabs from the Eastern Shore of Virginia. A 2018 research paper indicated that prevalence of parasite infection in Coastal Bays crabs varied significantly by year (2014-2016). Infection prevalence and intensity typically peaked in summer.
	1.4.2. DNR will define the criteria under which a Marine Protected Area can be effective in assessing the impacts of *Hematodinium* on blue crabs	The Coastal Bays Fisheries Advisory Committee discussed MPAs in the past, without any specific outcome. This committee disbanded, and fishery issues are now discussed with forums two times a year and through the Maryland Coastal Bays Program http://www.mdcoastalbays.org/
Obj. 2. Improve our understanding of blue crab biology and stocks. Prob. 2.1: Stock Status	**Action 2.1.1.** Adopt an overfishing threshold consistent with the Chesapeake Bay that preserves a minimum of 10 percent of the blue crab's spawning potential (F_{10} percent), and a fishing target that preserves 20 percent of an unfished stock. (F_{20} percent).	No targets and thresholds have been determined for Coastal Bays blue crabs. Reported landings of hard, soft and peeler crabs from the Coastal Bays was 0.9 million lbs (2021). Average landings have been approximately 1.3 million lbs.
	2.1.2. DNR will work towards implementing the necessary research and monitoring programs to determine the appropriate fishing mortality rates that will achieve the established fishing target of F_{20} percent. (Chesapeake Bay mortality rates (fishing and natural) are not necessarily transferable to Maryland's Coastal Bays.)	There is no direct blue crab monitoring in the Coastal Bays, but data is collected through the Coastal Fisheries Program trawl and beach seine surveys. Research needs have not been defined.
	2.1.3. DNR will work toward allocating funds specific to the Department's Coastal Bays blue crab monitoring program and data analysis.	No specific funds are designated for blue crab monitoring in the Coastal Bays, but data is collected through an ongoing fisheries monitoring program.
	2.1.4. DNR and MCBP will encourage research that examines the stock - recruitment relationship of blue crabs in the Coastal Bays, level of localized reproduction and entrapment of larvae, and effects of environmental parameters which influence fluctuations in crab abundance (i.e. including this action in the FMP will identify these research needs as a high priority, which will better enable DNR, MCBP, Universities and others to obtain support for funding these research projects).	No research completed.

	2.1.5. DNR will examine the utility of developing a public outreach indicator(s) of blue crab abundance that can be used to inform the community on the annual status of blue crab stocks in the coastal bays.	Dependent on all the actions specified in Objective 2.
Prob 2.2: Commercial Catch and Effort Data.	**2.2.1.** DNR will establish, implement and evaluate a commercial reporting monitoring program to obtain accurate catch and effort data from anyone crabbing commercially in Worcester County consistent with recommendations of the Atlantic Coast Cooperative Statistics Program. a) Evaluate the effectiveness of the A pilot@ daily logbook reporting system, implemented in 2000 for commercial crab harvesters and dealers in Worcester Co b) Consider using the Chesapeake Bay's commercial crab reporting system, but make it specific to the coastal bays, including more detailed information on location of harvest and effort data.	As a result of the pilot project, blue crab reporting went from a monthly summary to a daily logbook. The daily logbook program was expanded to the entire state in 2001. A pilot study was conducted in the Chesapeake Bay during 2012 to evaluate the use of an electronic reporting system to improve the timely reporting of catch statistics. This electronic harvest reporting program is currently available to harvesters reporting commercial crab harvest from the Coastal Bays.
	2.2.2. DNR will improve the enforcement of mandatory monthly reporting	A voluntary electronic reporting program is currently available to harvesters reporting commercial crab harvest from the Coastal Bays. This option for daily harvest reporting should provide improved and timely commercial harvest reports.
Prob. 2.3: Recreational Catch and Effort Data. .	**2.3.1.** DNR will design and implement a recreational crabbing survey in the coastal bays consistent with the pilot recreational crabbing survey in Chesapeake Bay.	A project to determine the design of a survey was completed. Implementation has been limited due to lack of funding. A Maryland Volunteer Angler Survey started in 2008, and was expanded in 2009. It includes blue crabs, but there has been limited response.
	2.3.2. DNR will identify potential funding mechanisms to fund and complement monitoring efforts outlined in Strategies 2.3.1 and 2.1.1.	No funding has been identified.
Prob. 2.4: Invasive, Non-indigenous Species	**2.4.1.** DNR will continue to monitor the abundance and impact of green crabs and other invasive, non-indigenous crab species.	Ongoing but limited due to lack of funding. In eastern North America, green crabs have been shown to significantly reduce populations of shellfish including soft shell clams, scallops and hard clams.
	2.4.2. DNR will evaluate the following management strategies related to green crabs: a) DNR will prohibit the possession and sale of imported green crabs, and promote the harvest and sale of locally harvested green crabs. b) DNR will prohibit the importation and sale of green crabs.	Green crabs have not been prohibited as bait. They are prohibited from being transported (COMAR 08.02.19.04)
	2.4.3. DNR will continue to work with Maryland's Non-Indigenous Species Task Force to examine invasive species issues, and develop an Aquatic Nuisance Species Plan to become eligible for Federal funding.	An Aquatic Nuisance Species Task Force developed a management plan for green crabs for the entire U.S. in 2002. The Maryland Aquatic Nuisance Species Management Plan was completed in November 2016. The European green crab was identified as a high priority species.

	2.4.4. MCBP will develop an outreach program (i.e. brochures) to educate the Coastal Bays community on the impacts of exotic species.	Impacts of exotic or non-native species were included in *Shifting Sands* (2009), a book about the Coastal Bays.
Prob. 2.5: Functional Role of Blue Crabs in the Natural Ecological Community.	**2.5.1.** DNR will examine methods/studies to better understand the natural ecological functions of blue crabs in the Coastal Bays, including the establishment of a Marine Protected Area in the Coastal Bays.	No studies have been conducted on marine protected areas.
Obj.3. Maintain an economically stable and sustainable commercial blue crab fishery.	**3.1.1.** DNR will improve the accuracy of effort data in the Coastal Bays' commercial blue crab fishery by implementing actions related to Problem 2.2 - Commercial Reporting.	See comments Action 2.2.1 and Action 2.2.2.
	3.1.2. DNR will continue to manage the Coastal Bays commercial blue crab fishery through the use of time limits, seasons, gear restrictions, catch limits, size limits, limited entry, and other management strategies as necessary, to prevent further increases in fishing effort. a) Gear Restrictions - Prohibit the taking of blue crabs in the Coastal Bays by scrape and dredge to prevent these fisheries from developing, and lessen the gear impacts on blue crab habitat; b) Time Restrictions - Establish similar time restrictions to those in the Chesapeake Bay to prevent a shift in crabbing effort from the Chesapeake Bay to the Coastal Bays during years when crab abundance is low in the Chesapeake Bay. 1) For 2001 - Prohibit the taking of crabs for commercial purposes between 2:00 p.m. and 5:30 a.m.	Completed. Prohibition of scrapes and dredges has been enacted. (COMAR.08.02.03.12E) Time restrictions have been enacted. (COMAR.08.02.03.12D) Closed season enacted: November 1 to April 1. (COMAR 08.02.03.12C) In 2017, the time restrictions were changed from a fixed time to: sunrise to 8.5 hours after during April and October and ½ hour before sunrise to 8 hours after from May-September except for between 1-1/2 hours before sunrise to 8 hours after sunrise on Memorial Day, July 4, Labor Day, and the day immediately preceding each of those holidays.
Prob. 3.2: Harvest of Female Crabs,	**3.2.1.** DNR will continue to prohibit the harvest of sponge crabs and limit the taking of female crabs in the coastal bays through the use of time limits, seasons, area closures, gear restrictions, catch limits, and size limits, as necessary. a) Area Closures - DNR will delineate areas where female blue crabs are concentrated (Action 5.2.1(a)) and determine the appropriate time periods for which commercial crabbing and hydraulic clam dredging should be allowed within these areas. The following areas have been identified as potential closure areas, but need to be delineated further: 1) The Convention Hall site, bayside of Ocean City, roughly between 36th and 50th Street; and 2) The Therefore site, in southern Isle of Wight Bay; 3) The Bridge site, just north of the Verrazano Bridge on the barrier island side. b) Catch and Size Limits - Determine if the current catch and size limits for female crabs are appropriate.	Continue. Hydraulic Clam Dredging is currently prohibited in Maryland's Coastal Bays, 2007. Natural Resources Article, §4-1002, Annotated Code of Maryland
	3.2.2. DNR will investigate the economic impact of prohibiting the possession and sale of sponge crabs within the state.	Completed. (Lipton and Sullivan 2002).

Prob. 3.3: Wasteful Harvest Practices.	**3.3.1** DNR will require unobstructed cull rings in crab pots from June 1 through April 30, and will adjust cull ring requirements based upon further research (peeler pot cull ring study being planned on Chesapeake Bay).	Continue.
	3.3.2. DNR will determine if measures are necessary to reduce the bycatch mortality of crabs in the hydraulic clam dredge fishery (i.e. Action 3.2.1(a) - prohibition of hydraulic clam dredging in areas where female crabs are concentrated).	Hydraulic Clam Dredging is currently prohibited in Maryland's Coastal Bays, 2007. Natural Resources Article, §4-1002, Annotated Code of Maryland
	3.3.3.DNR will continue to require terrapin excluders in crab pots set for noncommercial purposes, encourage watermen to install terrapin excluders in commercial crab pots, and investigate the feasibility (i.e. effects on catch; economic impact) of requiring terrapin excluders in all crab pots set in the Coastal Bays.	Continue. (Lukacovic et al. 2005)
	3.3.4. MCBP will coordinate an annual/seasonal volunteer effort to locate and remove derelict pots.	Continue with the annual Marine Debris Plunder event.
Obj. 4. Improve the recreational crabbing experience. Prob. 4.1: Satisfaction of Recreational Crabbers.	**4.1.1.**DNR and MCBP will obtain information on satisfaction levels of recreational crabbers in the Coastal Bays to evaluate the effectiveness of management measures.	No recreational crabbing surveys have been completed but recreational crabbers are able to participate in the Maryland Volunteer Angler Survey which gives crabbers an opportunity to express their satisfaction level with their trip.
	4.1.2. DNR will examine the effects of habitat quality on the success rates of recreational crabbing in the coastal bays.	No studies have been conducted.
	4.1.3. DNR and MCBP will develop and distribute the following information pertaining to the recreational crab fishery in the Coastal Bays: a) Recreational crabbing brochure summarizing crabbing restrictions; b) Recreational crabbing sign for access points (i.e. boat ramps and fishing/crabbing piers); c) Maps of land-based public access and boat based crabbing locations, list of boat ramps and marinas with rental boats, and recreational crabbing tips.	Continue with the annual Maryland Guide to Fishing and Crabbing and the online Maryland Public Water Access Guide.
	4.1.4. DNR, MCBP, the Town of Ocean City and Worcester County will work towards increasing the number of land-accessible areas for recreational crabbing.	Continue.
Obj. 5. Protect, maintain and enhance blue crab habitat. Prob. 5.1: Submerged Aquatic Vegetation (SAV).	**5.1.1.** DNR will alleviate the impact of hydraulic clam dredging and prop scarring to SAV in the Coastal Bays by: a) Prohibit hydraulic clam dredging in SAV; b) Annually documenting the areas and extent of impact; c) Researching seagrass recovery time; d) Investigating the use of buoys to mark beds, SAV setbacks, depth restrictions, GPS equipment to identify boundaries, and education as tools to protect beds from damage; and e) Implementing and enforcing necessary regulations to protect SAV from hydraulic clam dredging.	Completed. Hydraulic Clam Dredging is currently prohibited in Maryland's Coastal Bays, 2007. Natural Resource Article, §4-1002, Annotated Code of Maryland
	5.1.2. By implementing Action 3.1.2, DNR will prohibit the taking of blue crabs in the Coastal Bays by scrape and dredge to prevent these fisheries from developing and impacting SAV.	Completed.

	5.1.3. DNR and MCBP will continue to identify SAV species needing protection and activities needing restrictions.	Continue
	5.1.4. MCBP will expand surveys/citizen monitoring to ground truth SAV species composition, and determine accuracy of photo interpretive maps.	In 2020 SAV in the coastal bays increased by 14%. The Coastal Bays aerial SAV survey results were not available for 2021. SAV beds in Maryland's Coastal Bays appear to be an important area of primary habitat for fish.
	5.1.5. DNR and Natural Resources Conservation Service (NRCS) will develop habitat requirements for the growth of seagrasses in the Coastal Bays by: a) DNR will develop water quality requirements for seagrasses; b) DNR will identify areas that meet water quality requirements for restoration purposes; c) NRCS will compile data relating Coastal Bay soil types to bottom communities, and identify other variables having effects on seagrass establishment and maintenance, and d) NRCS will complete a soil mapping effort for the Coastal Bays	a) Completed (Maryland Department of Natural Resources 2004). b) Continue. c) Completed by MGS and DNR. d) Not yet initiated.
Prob. 5.2: Overwintering Habitat.	**5.2.1.** DNR will identify and protect blue crab overwintering areas in the coastal bays by: a) Delineating and mapping overwintering areas, and b) Prohibiting hydraulic clam dredging in important overwintering areas year-round, unless data indicates that these areas can be opened on a seasonal basis (see Action 3.2.1(a)). c) DNR will define the criteria under which a Marine Protected Area can be effective in protecting blue crab overwintering areas.	a) No mapping has occurred for blue crabs. b) Hydraulic clam dredging is prohibited (2007). c) No steps have been taken to define marine protected areas.
Prob. 5.3: Shallow Water and Shoreline Habitats.	**5.3.1.** DNR will support actions in the CCMP, specifically "Challenge 1.9 of the Fish and Wildlife Section," to protect and enhance shallow water and shoreline habitats important to blue crabs. DNR and Worcester County are the lead agencies for most of these actions. Refer to the CCMP for more specific information on these actions.	Continue. The CCMP was revised in 2015.
Prob. 5.4: Dissolved Oxygen.	**5.4.1.** DNR will support actions in the CCMP, specifically in the "Water Quality" section and "Fish and Wildlife" section to minimize the impacts of unsuitable dissolved oxygen levels on blue crabs in the Coastal Bays. Maryland's Coastal Bays Program, Town of Ocean City, and Worcester County are the lead agencies for the majority of these actions. Refer to the CCMP for more specific information on these actions.	Continue. (MD DNR 2004). In 2013 the CCMP went through a thorough review to update strategies and actions which resulted in an updated CCMP in 2015.
	5.4.2. DNR will identify areas which have unsuitable levels of dissolved oxygen (i.e. < 3 mg/L) for blue crabs.	Continue. (MD DNR 2004).
Prob. 5.5: Nutrient, Sediment and Chemical Inputs.	**5.5.1.** DNR will support actions in the "Water Quality" section of the CCMP to control nutrient, sediment and chemical inputs which will protect and enhance blue crab habitats. Worcester County and Maryland's Coastal Bays Program are the lead agencies for the majority of these actions. Refer to the CCMP for more specific information on these actions.	Continue. (MD DNR 2004). The combined 2019-2020 report card score for Maryland's Coastal Bays was C+.

Obj. 6. Improve enforcement of crabbing restrictions. Prob. 6.1: Enforcement of Conservation Measures.	**6.1.1.** DNR will consider increasing the number of enforcement personnel in the Coastal Bays, specifically during the crabbing season.	Continue. NRP hires seasonal staff to increase patrols during summer months. Penalties for violating regulations and enforcement procedures have been enhanced over the past several years.
	6.1.2. DNR will consider expanding the Natural Resource Police reserve officer program.	Continue. The reserve officer program is composed of volunteers committed to performing non-law enforcement duties that would otherwise be performed by commissioned police officers.

Acronyms

CCMP – Comprehensive and Conservation Management Plan
COMAR – Code of Maryland Regulations
Coastal BCFMP – Coastal Bays Blue Crab Fishery Management Plan
CPUE – Catch per unit effort
FMP – Fishery Management Plan
MCBP – Maryland Coastal Bays Program
MD DNR – Maryland Department of Natural Resources
MGS – Maryland Geological Survey
MPAs – Marine Protected Areas
NOAA – National Oceanographic and Atmospheric Administration
NRCS – Natural Resources Conservation Service
NRP – Natural Resources Police
SAV – Submerged Aquatic Vegetation
UMES – University of Maryland Eastern Shore
VIMS – Virginia Institute of Marine Science

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2021 Maryland FMP Report (December 2022)
Section 11. Maryland Coastal Bays Hard Clam (*Mercenaria mercenaria)*

Since 1993, the MD DNR Shellfish Division has conducted fishery-independent hard clam surveys in the Maryland Coastal Bays. Unfortunately, the survey could not be conducted in 2021 for the second year in a row. Reliably securing a vessel for the survey has proven to be problematic. The survey was not conducted in 2020 due to concerns over COVID-19.

Fishery Management Plan (FMP)

Recognizing Maryland's Coastal Bays as a separate, unique ecosystem from the Chesapeake Bay, a Comprehensive Conservation Management Plan (CCMP) was adopted for Maryland's Coastal Bays in 1999. The plan recommended that the Maryland Department of Natural Resources (MD DNR) address fishery issues specific to Maryland's Coastal Bays, including those related to hard clams, the primary molluscan shellfish resource in the region. In accordance with this plan, a Coastal Bays Hard Clam Fishery Management Plan (Coastal Clam FMP) was adopted in 2002 to conserve the coastal stock, protect its ecological and socio-economic values, and optimize the long-term utilization of the resource. During 2010, the Coastal Clam FMP was reviewed by the Plan Review Team (PRT). The PRT recommended a revision of the plan because the majority of actions are no longer valid due to the ban on mechanical harvesting. A timeline for revising the plan has not been developed.

The state of the Maryland Coastal Bays is annually assessed through an environmental report card process which takes into account several metrics, including hard clam densities from the MD DNR surveys. The 2019 and 2020 scores have been combined since data was variously absent for some of the metrics during those years. The overall score for 2021 was a grade C+; the same as the combined 2019/2020 score. https://mdcoastalbays.org/the-programs/science/report-cards/

Stock Status

Thirteen years have passed since the mechanical harvesting of shellfish was legislatively prohibited in the Coastal Bays. At the time of the prohibition, hard clam densities were well under the benchmarks established from surveys conducted in 1952-1953 and in some bays were at near-record lows. Since then, the response of the component hard clam populations to the drastic reduction in harvest pressure has trended in the positive direction, but at varying rates of increase, with most of the bays still below their baseline values. Observed mortalities have been negligible throughout the bays. The Coastal Bays populations are generally dominated by older, larger clams, with recruitment low and sporadic in the lower bays.

Since the ban on mechanical harvesting, there has been a sharp rise in clam densities from Sinepuxent Bay northward. These density increases were episodic, jumping as a stepwise function as a result of a strong recruitment period during the late 2000s. The upsurges were followed by a plateauing at the next level for several years, rather than a smooth and continuous increase. Perennially the tributary with the lowest hard clam densities, the St. Martin River population, surpassed its benchmark as early as 2014, but it was a comparatively low mark. Isle of Wight Bay has been the only other embayment to exceed its 1953 baseline, and that only occurred in 2019 (Figure 1). Sinepuxent Bay also experienced strong increases in clam numbers but is still below its 1953 density. Chincoteague Bay, historically the primary focus of the hard clam fishery, has never recovered its early status as having the highest clam densities of the Coastal Bays. This bay's clam population essentially has been flatlined over the past 26 years (Figure 1). Although densities have doubled since the record lows during 2008 to 2010, they are only back to the already depleted levels of the 1990s/early 2000s and remain a fraction of the historical benchmark.

It has become evident that despite the absence of harvest pressure, recovery of this species requires an extended period of time, on the order of a decade or more. While the upper bays have made great strides with increased clam abundances, the Chincoteague Bay population remains mired at low densities. Given the currently depressed density status, the history of poor and sporadic recruitment, and shifting environmental and habit conditions, it may take up to several decades for the Chincoteague population to return to its historical benchmark density.

The causes of these generally slow recovery rates have not been determined. Low population densities can reduce spawning efficiencies and consequent recruitment, thereby maintaining low clam densities. Other causes of recruitment failures may be due to unfavorable water quality conditions (such as harmful algal blooms) for hard clam survival, especially for vulnerable life history stages (e.g. larvae, newly settled spat)[1] and possibly increased predation. The primary predator on juvenile hard clams is blue crabs.[2] Other species that prey on clams are oyster drills, moon snails, whelks, mud crab, sea stars, cownose rays, horseshoe crabs, herring gulls, waterfowl, and finfish (such as tautog, puffer, black drum, and flounder).

Current Management Measures

Hard clam minimum size limit is 1 inch in the transverse dimension and only hand-held harvesting devices are allowed in the Coastal Bays. In 2007, the Maryland

state legislature passed a law prohibiting the harvesting of clams and oysters in the Coastal Bays by hydraulic escalator dredge, power dredging, or other mechanical means. This statute went into effect in September 2008, resulting in a further reduction of the commercial fishery. The fishery may pick up at some point in the future, if stocks build to densities high enough to support manual means of harvesting. The minimum size for the recreational fishery is 1 inch (transverse measurement), with a 250 per person per day limit; a license is not required.

The Historical Fishery

The hard clam historically has been an important species both in terms of sustenance and commerce. In addition to being items of food for the indigenous people of the Coastal Bays, the clams were highly valued as a source of purple shell for making wampum beads, the common currency of exchange among tribes all along the Atlantic coast. During more recent times, the hard clam was one of the species that flourished in the coastal bays after the Ocean City Inlet opened in 1933, which increased salinities. Prior to that time, the population was confined to the higher salinities in southern Chincoteague Bay, where the only inlet existed. Significantly, the improvement of commercial shellfish resources was one of the primary rationales for allocating funds to construct and stabilize a new inlet. Just before construction was to begin, a hurricane serendipitously breached the island at the southern edge of Ocean City, which the Army Corps of Engineers quickly stabilized. New clam populations and an associated fishery consequently developed throughout the bays. Landings peaked in 1969 at 760,000 lbs following the introduction of hydraulic escalator dredges. Harvests rapidly declined afterwards so that by 1973 it was only 61,000 lbs. Depleted landings persisted into the mid-1990s, when they averaged less than 25,000 lbs per year. Successful recruitment during this period was followed by a resurgence in landings, which exceeded 100,000 lbs in 1999 and peaked at 197,000 lbs in 2002 (Figure 4). Since the prohibition of hydraulic dredging in 2008, a small commercial fishery continues, primarily using hand rakes. The latest available coastal reported harvest was 13,929 individual clams in 2019, or approximately 537 lbs.[3] The hard clam is also the basis of a recreational fishery, especially for tourists that visit the region during the warmer months. Harvest from the recreational fishery is unknown.

Aquaculture

Shellfish aquaculture harvests again declined in 2021, possibly due to the continued impact of COVID-19 on markets. The 2021 harvest was 1,939 bushels of oysters, a decrease of 434 bushels or 18% from the previous year. This drop was substantially less than the 1,738 bushel loss between 2019 and 2020. The number of active leases (15) and acreage (68.1 acres) remained the same as the previous year. Most of the harvest was attributable to oysters from water column leases. No clam harvests were reported. However, 83.4 bushels of bay scallops were produced for the first time.

The trend in aquaculture prior to 2020 was one of slow but steady annual increases in landings, while paradoxically the actual number of leases and acreage declined from its peak in 2015, when there were 19 active leases covering 181 acres. Initially, both hard clams and oysters were being raised, but this has shifted to all oysters in recent years. All of the decline was in subtidal leases, which fell from eight leases encompassing 92 acres in 2017 to two leases covering 15 acres in 2020. In contrast, water column leases modestly grew from 11 leases and 47 acres in 2017 to 13 leases and 53 acres in 2021. Despite the decline in the number of leases, production actually increased from 525 bushels in 2015 to 823 bushels in 2016, 1,594 bushels in 2017, 2,262 bushels in 2018, and 4,111 bushels in 2019, before declining in 2020 and 2021 (Figure 3).

Issues and/or Concerns

The stubbornly slow recovery of hard clam stocks, despite the twelve-year prohibition on mechanical harvesting, is the foremost issue concerning this species, especially in Chincoteague Bay. Aside from the dredging prohibition, restoration actions are limited to concentrating broodstock to enhance spawning efficiency, which continues on an annual basis during the clam surveys. Repeated calls for opening the fishery to mechanical harvesting with scrape-type dredges (similar to oyster dredges) before stocks attain sustainable levels would further inhibit recovery.

Many of the strategies and actions in the 2002 Coastal Bays Clam FMP were developed to address hydraulic dredging. Since the use of hydraulic dredges is prohibited, these strategies and actions are now obsolete. Consequently, the development of a new plan has been recommended, but a timeline has not been established.

User conflicts and stakeholder opposition, especially from shoreline property owners, continue to hinder the expansion of shellfish aquaculture in the Maryland Coastal Bays. One lease application initiated in 2009 was finally approved in 2016.

Non-native green crabs (*Carcinus maenas*) have been introduced, most likely as bait, in the bait bucket trade. This species has been recognized by the federal Aquatic Nuisance Species Task Force as an aquatic nuisance species. Green crabs are clam predators, and their impact on the hard clam population is uncertain. Although small pockets of green crabs may be established in the Coastal Bays, they are neither abundant nor widely distributed. The green crab is listed as a “species prohibited from transport” in MD (COMAR 08.02.19.04) and they may not be collected or used as bait in areas where they are not established.

Compliance with the National Shellfish Sanitation Program (NSSP) model ordinance is currently in place and affects the handling of hard clams intended for human consumption. Handlers are required to cool clams and deliver them to Maryland Department of Health (MDH) certified shellfish dealers within 12 hours after harvest (or cooled to specific temperatures within 12 hours).

Figure 1. Chincoteague and Isle of Wight bays hard clam densities before and after the dredging ban and the historic benchmark densities (MD DNR data).

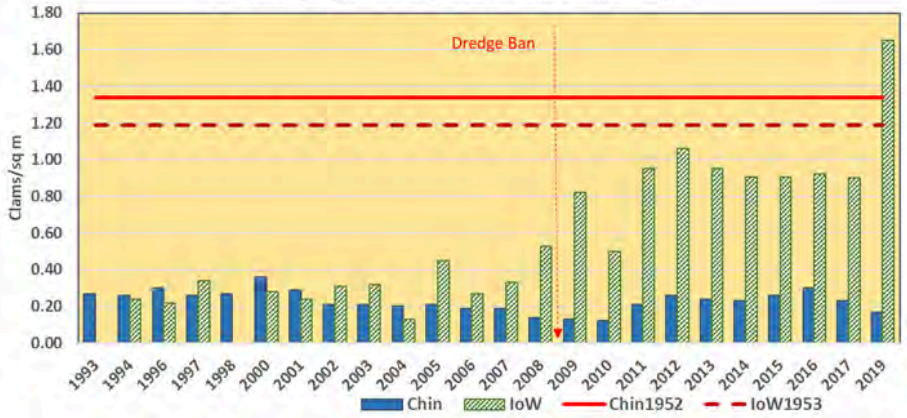


Figure 2. Maryland Coastal Bays hard clam landings, 1990-2019. No landings were reported in 2009, 2020, and 2021 (MD DNR data).

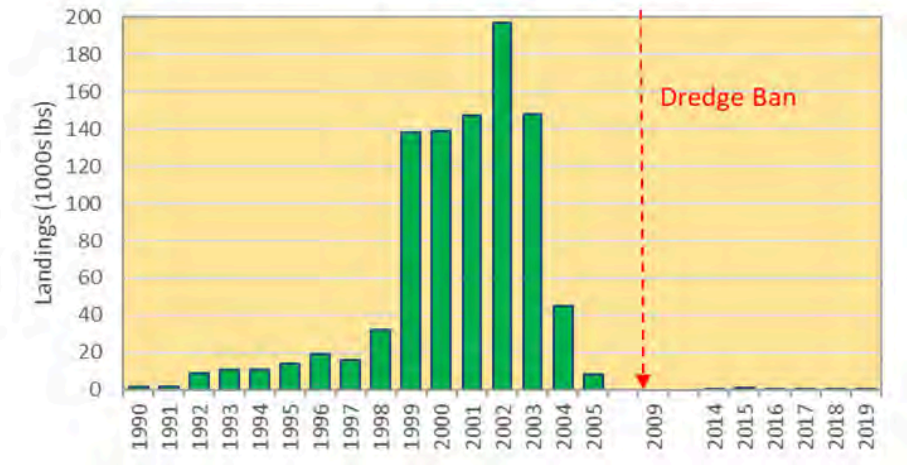
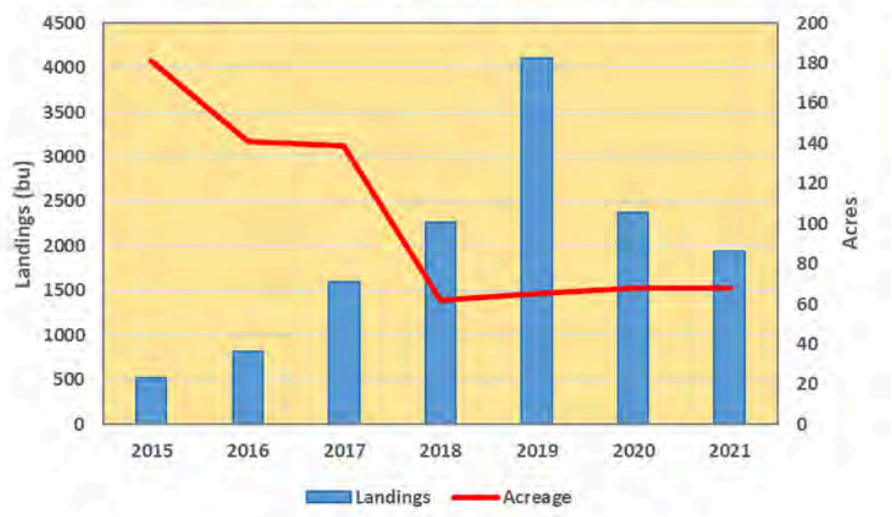


Figure 3. Maryland Coastal Bays aquaculture landings and acreage under lease, 2015 - 2021



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[3] Maryland Department of Natural Resources landings records

[4] Waterway Improvement Capital Program Benefits, Needs, and Opportunities. 2011. Legislative report prepared in response to the 2011 Joint Chairman's Report, Sept. 2011. 23p.

2002 Coastal Bays Hard Clam Fishery Management Plan		
Objective/Problem	**Action**	**Implementation**
Obj.1. Enhance and perpetuate hard clam stocks. Prob 1.1: Mortality of Small Clams	1.1.1 Investigate the importance of habitat closures (MDE restricted areas, SAV closures, and shoreline setback areas) to recognize their benefits as hard clam broodstock protection areas.	Continue. Results to date have not shown significant improvement in clam densities within SAV beds. With the prohibition on mechanical harvesting, there has been little commercial activity for the past 11 seasons, providing a means to track the impact of closures on hard clam stocks. Limited recreation-only harvest areas and sanctuaries are preferred alternatives to closures and moratoriums.
	1.1.2 Develop an action plan for improving hard bottom habitat (i.e., shell or other suitable substrate) to reduce predation on small clams. The action plan will include the identification of: a) Planting materials and sources; b) Enhancement areas, and c) Funding sources (i.e. improved reporting of commercial hard clam harvest will increase funding generated through the shellfish tax which could be used towards bottom enhancement activities).	Pilot studies on habitat improvement indicate that clam survivorship is enhanced, but not sufficiently high enough, to justify the expense and logistical difficulties associated with such activities. The absence of commercial harvesting resulted in no tax revenue for the past 11 years.
Obj.2. Manage for a viable commercial hard clam harvest to maintain an economically stable fishery. Prob. 2.1: Potential Economic Hardship to Commercial Clammers Caused by the "Boom and Bust" Nature of the Fishery	2.1.1 MD DNR will limit the number of individuals into the commercial hard clam fishery by permit only, based upon those individuals who have landed at least 100 bags of hard clams (as documented by MD DNR dealer reports) in Maryland's Coastal Bays in at least 2 years, between the 1990/91 and 2000/01 seasons. Using these criteria, a total of 22 individuals would qualify for this permit. This permit should be transferable with a license, or to an individual who purchases a clam rig from an individual who meets the criteria stated above, and relinquishes their permit to the new clam rig owner. MD DNR will evaluate this action within 3 years to determine if the desired outcomes are being achieved. This action is consistent with actions 5.1.2 and 6.1.3.	Completed. However, lawyers determined that this was legally inadvisable. This objective and action need further investigation and discussion, given the lack of commercial harvest. Limited entry and IFQs continue to be discussed.
	2.1.2 MD DNR will develop a plan (i.e. reporting requirement from commercial clammers) to improve the collection of catch, effort and economic data from the commercial hard clam fishery, to assist managers in evaluating the impacts of future management decisions.	There are gaps in the hard clam harvest data, but harvest can be estimated from buy tickets (if the hard copies are still available). There has been no commercial harvesting during the past 11 seasons. Commercial clam harvesters in all Maryland waters are required to report their daily catch of all clam species since September 2011.
Obj. 3. Evaluate the feasibility of hard clam aquaculture opportunities. Prob 3.1: Establishing Hard Clam Aquaculture	3.1.1 Evaluate the legal, institutional and economic incentives and barriers to private aquaculture at the local, state, and federal level in Maryland.	This was done as part of the Maryland Legislative Task Force on Seafood and Aquaculture. MD DNR has been the lead agency since July 1, 2011 in permit processing. An aquaculture training conference was hosted by UMD, in cooperation with MD DNR, NOAA CBO and the Oyster Recovery Partnership. Three aquaculture open houses were held in 2010.

		An aquaculture financing loan program was announced under Gov. O'Malley. Representatives from the Maryland Oyster Aquaculture Financing Program discussed the loan program at the aquaculture open houses, and began the business planning and application processes. MD DNR and MDH launched a commercial shellfish tagging program, beginning in October 2011, to meet the requirements of the National Shellfish Sanitation Program (NSSP). Hard clam tagging was implemented in the 2012-2013 license year. Other changes (such as taking and landing times, cooling, shading), needed to comply with NSSP changes, have been implemented through regulation.
	3.1.2 Identify problems with the permitting process and make recommendations to specific agencies to solve those problems.	This was done through the legislative task force, reinforced with information from a range of states at the Maryland Aquaculture Development Conference held in Annapolis in August 2003. The permitting process has improved, and will continue to address the myriad laws and regulations of the past 100 years, which preserved wild harvest at the expense of aquaculture.
	3.1.3 Simplify the application process, and designate a single point contact at MD DNR to assist potential applicants with aquaculture permits, questions related to the regulatory requirement, guidance through the permitting process and fulfilling regulatory obligations, tracking permit applications, and coordinating state agency permitting activities to aquaculture permits.	The leasing laws were entirely revised in 2009, including the provision for pre-approved lease areas in the Coastal Bays to streamline the process. Two areas have since been pre-approved: South Point Shoal and Whale Gizzard Shoal. Because these areas have been pre-screened for leasing conflicts, the application process is shorter. MD DNR has been designated as the lead agency for coordinating all aquaculture permitting as of 7-01-11 (SB 847 & HB 1053). MD DNR will issue water column leases and staff the Aquaculture Coordinating Council and Aquaculture Review Board. The lease application was simplified in 2010. It is now a single joint application with the US Army Corps of Engineers, Baltimore Office and MD DNR. One lease for hard clam aquaculture was approved in 2010. One additional applicant pursued a submerged land lease application in 2012.

		One older lease hard clam aquaculture operation began reporting harvest under new reporting requirements in effect since June 2012.
	3.1.4 MD DNR will evaluate the feasibility of hard clam aquaculture in Maryland's Coastal Bays by: a) Identifying potential areas and size of area for hard clam aquaculture; b) Initiating and providing funding for pilot hard clam aquaculture studies; c) Investigating the economic impact of hard clam aquaculture, and d) Assessing the ecological impacts associated with hard clam aquaculture	a) This was not meant to designate where shellfish farmers would be compelled to site their operations (already taken care of in MD law regarding leasing). It should be used as a point of reference for the types of bottoms that are most beneficial for producing hard clams and oysters. Pre-approved leasing areas have been evaluated and proposed. b) This has been done through the development of a shellfish nursery at Gordon's Shellfish (supported by the MIPS program), and trials with several types of production methods. Information on what works best according to the bottom types and circulation patterns in the area, and the management objectives of the operator have been considered. The aquaculture industry has progressed beyond the pilot phase to expanding production, albeit on a relatively limited scale and growing oysters instead of hard clams. c) Ongoing - but hard clam aquaculture has revolutionized the Florida fishing industry, and kept many former fishermen in business when they had few other options. It is a multi-million-dollar industry in VA, where the production of high-quality shellfish is ahead of MD. d) An extensive literature review was presented to the Coastal Bays STAC in 2001. A study of the incidence of the clam disease QPX (MD DNR/VIMS) was completed. Continue to monitor mortality in farmed clams for disease (none reported). MD DNR conducted a study of hard clam growth in the presence of brown tide. Proposals were submitted to fund a two-year study on commercial hard clam aquaculture and SAVs, but because of budget problems, neither has been funded. A literature review was presented to the Coastal Bays STAC.
Obj 4. Enhance and promote the recreational hard clam fishery.	4.1.1 MD DNR will develop and distribute a public outreach brochure, illustrating recreational clamming areas, access points, methods and harvest restrictions.	This is a low priority and has not been initiated. Increased education on recreational harvest should include the responsibility and mechanism to report harvest. This may be an opportunity for Coastal Bay Program input.

Prob. 4.1: Limited Access and Knowledge of Recreational Clamming Opportunities in Maryland's Coastal Bays	4.1.2 MD DNR will work with the Town of Ocean City and Worcester County to improve access to recreational clamming areas.	Boat ramps and associated facilities continue to be constructed and renovated, with funding provided in full or in part by the MD DNR Waterway Improvement Fund, funded by boat taxes. The West Ocean City Harbor ramp, built in 1988, was renovated over four months, and re-opened, June 2011. A new boat ramp was opened in Ocean City in 2017. Due to decreased revenues (50% since FY2006), MD DNR was able to fund only 19% of the state and local boating access and dredging projects.[4]
	4.1.3 MD DNR will investigate the feasibility of planting seed, to establish and/or enhance areas for recreational clamming, and if feasible, develop a seeding strategy.	Low priority and most likely will not be implemented.
	4.2.1 MD DNR will reduce the recreational catch limit for hard clams from 1 bushel to 250 hard clams per person per day.	Effected in 2002.
Obj.5. Minimize conflicts between Coastal Bay user groups and commercial hard clam fishermen. Prob. 5.1: Conflict Between Recreational Fishermen and Commercial Clammers.	5.1.1 MD DNR will prohibit commercial clamming in the area between the Ocean City Airport at Marker 13 northward, to the Rt. 90 Bridge on Saturdays (Sundays currently closed) between September 15 through October 15, and April 15 through May 31.	Effected in 2002. Action item to be moved to history/background in new FMP, which will be totally revised to include aquaculture.
	5.1.2 MD DNR will limit the number of individuals into the commercial hard clam fishery by permit only, based upon those individuals who have landed at least 100 bags of hard clams (as documented by MD DNR dealer reports) in Maryland's Coastal Bays in at least 2 years, between the 1990/91 and 2000/01 seasons. Using these criteria, a total of 22 individuals would qualify for this permit. This permit should be transferable with a license, or to an individual who purchases a clam rig from an individual who meets the criteria stated above, and relinquishes their permit to the new clam rig owner. MD DNR will evaluate this action within 3 years to determine if the desired outcomes are being achieved. This action is consistent with actions 2.1.2 and 6.1.3	Legally inadvisable (see Sec. 2.1.1). Action item to be addressed in 2.1.1.
	5.1.3 MD DNR will reduce the bycatch allowance of hard clams for recreational purposes in the hydraulic dredge fishery, from 1 bushel to 250 hard clams per person per day.	Effective in 2002. Action item is no longer needed.
Prob. 5.2: Conflict Between Shoreline Property Owners and Commercial Clammers.	5.2.1 MD DNR will establish a maximum noise level limit for commercial vessels consistent with the recreational limit.	Regulation clarified to reference existing reg. (COMAR 08.18.03.03) established maximum noise levels for all vessels in Maryland. This action item may be addressed in aquaculture permitting.
Obsolete – Mechanical harvesting now prohibited.	5.2.2 MD DNR will increase the shoreline setback distance, for which a person may not catch hard clams with a hydraulic dredge in front of federal or state-owned property, from 150 to 300 feet	Effective in 2002.
	5.2.3 MD DNR's Natural Resource Police will monitor the causes of reported noise complaints to facilitate future management decisions related to this issue.	A study conducted by NRP of five clam boats found that all were in compliance with muffler and noise level regulations.
	5.2.4 MD DNR will investigate the impacts of prohibiting or restricting the written permission provision that allows an individual to catch hard shell clams with a hydraulic dredge, within the shoreline setback of 300 feet.	Written permission provision eliminated in 2002.

Obj. 6. Minimize ecological impacts associated with the commercial and recreational hard clam fisheries. Prob. 6.1: Community Concern on the Ecological Effects of Commercial Hydraulic Clam Dredging.	6.1.1 MD DNR and Maryland's Coastal Bays Program will educate the public on the ecological effects of hydraulic clam dredging, and the importance of the commercial hard clam fishery to the coastal bays community.	A literature review was compiled documenting the impact of hydraulic escalator dredging, and other harvesting and natural disturbances on marine ecosystems in 2001.
Obsolete – hydraulic escalator dredges now prohibited.	6.1.2 MD DNR will encourage studies to evaluate the ecological impacts of hydraulic clam dredging in Maryland coastal bays.	Action is obsolete.
	6.1.3 MD DNR will limit the number of individuals into the commercial hard clam fishery by permit only, based upon those individuals who have landed at least 100 bags of hard clams (as documented by MD DNR dealer reports) in Maryland's coastal bays in at least 2 years, between the 1990/91 and 2000/01 seasons. Using these criteria, a total of 22 individuals would qualify for this permit. This permit should be transferable with a license, or to an individual who purchases a clam rig from an individual who meets the criteria stated above, and relinquishes their permit to the new clam rig owner. MD DNR will evaluate this action within 3 years to determine if the desired outcomes are being achieved. This action is consistent with actions 2.1.2 and 5.1.2.	Legally inadvisable (see Sec. 2.1.1). Action is addressed in 2.1.1.
Prob. 6.2: Direct Impact to Submerged Aquatic Vegetation (SAV) by Commercial Hydraulic Clam Dredging	6.2.1 MD DNR will continue to prohibit the use of hydraulic clam dredges in SAV beds, and will delineate existing SAV beds as necessary to maintain this protection over time.	Obsolete – hydraulic escalator dredges now prohibited.
Obsolete – hydraulic escalator dredges now prohibited.	6.2.1a The Maryland Coastal Bays Fishery Advisory Committee shall become the local group to develop and provide recommendations to MD DNR, regarding the delineation of SAV closure areas to harvest from hydraulic clam dredging.	Obsolete – hydraulic escalator dredges now prohibited.
	6.2.1b MD DNR will continue to foster support among legislators to make recommended changes in the SAV law, which would benefit all stakeholder groups by making the delineation and enforcement process more manageable, and the closure areas consistent over a longer period of time	Continue.
	6.2.2 MD DNR and the National Park Service will investigate the feasibility and funding options for using Global Positioning System (GPS) units to improve the ability for clammers to comply with SAV closure areas, and offset the maintenance cost associated with using buoys to identify SAV closure areas.	There has been no significant commercial activity for the past 11 seasons. No action to date.
Prob. 6.3: Potential Impact to Overwintering Blue	6.3.1 MD DNR will evaluate the need to restrict hydraulic dredging in important female blue crab overwintering areas by: a) Delineating female blue crab overwintering areas;	Preliminary study was conducted by the MD DNR Coastal Fisheries Program. Obsolete – hydraulic escalator dredges now prohibited.

Crabs by Commercial Hydraulic Clam Dredging. Obsolete – hydraulic escalator dredges prohibited.	b) Determining the significance or contribution of these overwintering crabs to the coastal bays blue crab population; c) Determining the magnitude of overwintering blue crab bycatch in the hydraulic clam dredge fishery, and d) Assessing the impact of dredging activity on overwintering female blue crabs.	
Obj. 7. Protect, maintain and enhance important hard clam habitats. Prob. 7.1: Water Quality	7.1.1 Develop strategies to restore water quality in areas closed to harvesting hard clams because of pollution.	Continue.
Prob. 7.2: Hard Bottom Habitat	7.2.1 Develop an action plan for improving hard bottom habitat (i.e. shell or other suitable substrate) to reduce predation on small clams. The action plan will include the identification of: a) Planting materials and sources; b) Enhancement areas, and c) Funding sources.	Studies on habitat improvement indicate that clam survivorship is enhanced, but not sufficiently high enough to justify the expense and logistical difficulties associated with such activities.
Prob. 7.3: Navigational Channel Dredging and Dredge Disposal.	7.3.1 The MD Coastal Bays Navigation and Dredging Advisory Group (NADAG) will seek comments from MD DNR's Shellfish Program on the potential impacts of proposed dredging activities on hard clams.	MD DNR is routinely consulted during the permitting process on projects that may impact hard clams.
Prob. 7.4: Growth of Noxious Algal Blooms.	7.4.1 MD DNR and MCBP will identify potential funding sources to support the following research and monitoring activities: 1) Assess the potential impact that noxious algal blooms have on hard clam populations, and 2) Identify factors which might contribute to noxious algal blooms.	MD DNR conducted a study on the impact of brown tide on clams in culture. Sampling for harmful algal blooms, and analyses of causes is ongoing.
Obj. 8: Minimize the impacts of non-indigenous invasive species. Prob. 8.1: Green Crabs.	8.1.1 MD DNR, with the advice of Maryland's Coastal Bays Fishery Advisory Committee, will implement measures to minimize the impact of green crabs and Japanese shore crab on the hard clam population in Maryland's Coastal Bays, and will coordinate this effort with Delaware and Virginia.	The green crab, Japanese shore crab and Chinese mitten crab were designated "high priority marine animals" in the Maryland Aquatic Nuisance Species Management Plan (2016). A Chinese Mitten Crab Watch has been developed to help the general public report occurrences of mitten crab.
	8.1.2 MD DNR will continue to work with Maryland's Non-Indigenous Species Task Force to examine invasive species issues, and develop an Aquatic Nuisance Species plan to become eligible for Federal funding	The Maryland Aquatic Nuisance Species Management Plan was completed and approved November 2016.
Obj. 9. Implement fisheries dependent and independent monitoring programs to obtain sufficient and accurate data for managing hard clams	9.1.1 MD DNR will continue to survey the hard clam resource on an annual basis in Maryland's Coastal Bays to facilitate management decisions.	Ongoing.

Prob. 9.1: Stock Assessment		
Prob. 9.2: Assessment of Bottom Enhancement Activities.	9.2.1 Design and implement a program to monitor the efficacy of bottom enhancement activities.	The results of pilot studies suggest that such a program would not be cost-effective. See action 7.2.1
Prob. 9.3. Commercial Catch, Effort and Economic Data.	9.3.1 MD DNR will establish, implement and evaluate a commercial reporting program to obtain accurate catch, effort and economic data from anyone harvesting hard clams in Maryland's Coastal Bays. This action is consistent with action 2.1.2.	Not yet initiated. There has been little commercial harvesting during the past 11 seasons.
Prob. 9.4: Recreational Catch, Effort and Economic Data.	9.4.1 MD DNR will facilitate the design and implementation of a recreational clamming survey in Maryland's Coastal Bays.	Questions on recreational clamming were included as part of a broader 2006 angler survey by UMES.

Acronyms

COMAR – Code of Maryland Regulations
MDH – Maryland Department of Health
FMP – Fishery Management Plan
FY – Fiscal Year
IFQs – Individual Fishing Quotas
MD DNR – Maryland Department of Natural Resources
MIPS – Maryland Industrial Partnerships
NOAA CBO – National Oceanographic and Atmospheric Administration, Chesapeake Bay Office
NRP – Natural Resource Police
QPX – Quahog Parasite Unknown
SAV – Submerged Aquatic Vegetation
STAC – Scientific & Technical Advisory Committee
UMD – University of Maryland
UMES – University of Maryland Eastern Shore
VIMS – Virginia Institute of Marine Science

2021 Maryland FMP Report (December 2022)
Section 12. Horseshoe Crab (*Limulus polyphemus*)

The Horseshoe Crab Adaptive Resources Management (ARM) Committee worked through most of 2020 and 2021 building a new model to recommend horseshoe crab bait harvest quotas taking into account red knot and horseshoe crab abundance. This model is very similar to the existing ARM model, but it uses new software and the target thresholds were reevaluated. The committee also incorporated the new stock assessment analysis and biomedical mortality information into the updated ARM model. This effort should be completed, peer reviewed, and approved by the ASMFC management board by the end of 2022.

Horseshoe crabs are important to many different stakeholders. Not only do they support several valuable commercial fisheries, but they also have an important biomedical role, and are a critical food source for migratory shorebirds. Horseshoe crabs and migratory shorebirds, particularly the threatened red knot (*Calidris canutus rufa*), have a unique ecological relationship. Red knots rely on horseshoe crab eggs as food during their spring migration from South America to their Arctic breeding grounds.

As a result of these relationships, the management of horseshoe crabs has a broad ecosystem approach, and is closely coordinated with the conservation efforts of migratory birds. The U.S. Fish and Wildlife Service (USFWS) identified climate change induced effects such as habitat impairment and loss, asynchronous timing with food resources, and predation as principal threats to migratory birds. The USFWS expressed confidence in the Atlantic States Marine Fisheries Commission's (ASMFC) Adaptive Resource Management (ARM) framework as a reasonable approach to ensure sufficient egg abundance to meet the needs of both red knots and horseshoe crabs.[1]

Fishery Management Plans (FMPs)

The Chesapeake Bay and Atlantic Coast Horseshoe Crab Fishery Management Plan (CBHSC FMP) was adopted in 1994 by the major jurisdictions in the Chesapeake Bay (Maryland, Virginia, and the Potomac River Fisheries Commission). The CBHSC FMP prohibited the harvest of horseshoe crabs during the spawning season as a conservation measure for protecting their eggs, and providing an important food resource for shorebirds. The plan established a spawning stock census of horseshoe crabs, stricter harvest reporting standards, and a program to delineate important spawning areas. The CBHSC FMP was reviewed in 2011, and the plan review team recommended amending the plan to address two issues: 1) adopt the ASMFC's ARM framework and 2) address the lack of genetic and spawning data for horseshoe crabs within the Chesapeake Bay.

In 1998, the ASMFC adopted the Interstate Fishery Management Plan for Horseshoe Crabs (ASMFC HSC FMP) along the Atlantic coast. Since then, there have been a number of changes. Addendum I (2000) established state-by-state quotas on horseshoe crab landings that were 25% below reference period landings. Addendum II (2001) allowed quota transfers between states. Addendum III (2004) further reduced commercial harvest, and added seasonal closures in New Jersey, Delaware, and Maryland. These additional restrictions were implemented to further increase horseshoe crab egg abundance to provide food for migratory shorebirds, including the red knot.

Addendum IV (2006) instituted seasonal and spatial harvest restrictions in Maryland and Virginia. Harvest restrictions apply only to the bait fishery. In addition, no more than 40% of Virginia's quota can be harvested east of the COLREGS line, as determined by the International Regulations for Preventing Collisions at Sea, and the "rules of the road" followed by vessels at sea. They must also have a minimum male to female ratio of 2:1 if landed in Virginia. Addenda V (2008) and VI (2010) continued the Addendum IV restrictions for Maryland and Virginia. Addendum VII (2012) implemented the ARM framework in 2013 to optimize horseshoe crab harvest, while conserving both shorebird and horseshoe crab abundance. The implementation of the ARM framework included a male only harvest for the Delaware Bay states and Maryland.

The ARM framework identified two circumstances that affect red knot demography and annual survival: 1) horseshoe crab abundance and red knot body mass at departure from Delaware Bay, and 2) arctic snow conditions upon arrival at the breeding grounds. As a result, the ARM workgroup developed five horseshoe crab management alternatives: 1) a full harvest moratorium on both sexes; 2) a harvest limit of 250,000 males and 0 females; 3) a harvest limit of 500,000 males and 0 females; 4) a harvest limit of 280,000 males and 140,000 females, and 5) a harvest limit of 420,000 males and 210,000 females. Alternative #3 is currently in place.

Stock Status

During 2019, the Atlantic States Marine Fisheries Commission (ASMFC) completed a new stock assessment and it was peer reviewed.[2] It was found that the Atlantic population was stable to good in all regions except for the New York area where the stock was considered poor. The stock assessment committee tasked the Adaptive Resource Management Committee (ARM) with incorporating the bycatch and biomedical harvest into the management matrix.

Horseshoe crabs caught in Maryland waters include individuals from three separate spawning stocks: Maryland, Virginia, and Delaware Bay. Mean catch of horseshoe crabs from the Maryland independent trawl survey, conducted in the Coastal Bays, indicates a variable but increasing trend in catch since 2002. Catch from this survey was above the grand mean in 2016-2018 and was equal to the grand mean in 2019-2021.

Egg density is a method used to assess abundance of horseshoe crabs, as well as the availability of food resources for migrating shorebirds. Peak egg density generally coincides with peak shorebird migration. Egg density on Delaware Bay and New Jersey beaches has been highly variable seasonally, annually, and spatially over the years. Changes in survey activity make trend analysis difficult. Generally, egg densities have been stable.

The U.S. Fish and Wildlife Service coordinates a coastwide tagging program. Biomedical, conservation outreach, and research entities tag horseshoe crabs annually. Since 1999, over 300,000 crabs have been tagged and released with a recapture rate of 12%.[3] The ASMFC Horseshoe Crab Technical Committee developed guidelines for the tagging program, so the data collected is more applicable to management issues.

A spawning survey is conducted in Delaware Bay annually and spawning activity has been stable since the survey began in 1999.[4]

Maryland DNR and the Maryland Coastal Bays Program (MCBP, one of the United States National Estuary Programs) have been conducting horseshoe crab spawning surveys in the Maryland Coastal Bays since 2002. Maryland DNR began assisting the program in 2006. The survey has changed over the years and currently samples from mid-May to mid-July at six sites: three sites sampled by MD DNR, and three sites sampled by MCBP volunteers. The survey provides MD DNR with information on the timing of horseshoe crab spawning, the location of spawning areas, and the magnitude of spawning activity on certain beaches. The survey information is given to ASMFC for coastal management consideration. The survey also supports educational and volunteer objectives for the general public, and has been highlighted on Maryland Public Television. Trends in spawning activity have been stable.

Biomedical mortality is monitored as part of the ASMFC management plan. A 15% rate was used in the 2013 stock assessment for biomedical bleeding and release mortality.[2] Coastwide biomedical harvest has increased, and estimated mortality was above the 57,500 horseshoe crab cap from 2007-2021. Total estimated mortality of biomedical crabs for 2020 was 106,339 crabs (at 15% post-bleeding estimated mortality).[3] The impact of biomedical mortality was evaluated during the stock assessment process and was determined that it did not have a significant impact on abundance.

Management Measures

Maryland's commercial fishery has operated under a quota system since 1998. Beginning in 2013, the harvest of female horseshoe crabs was prohibited and the quota is set for male horseshoe crabs only. Any overages are deducted from the following year's quota. Under Addendum III, it was established that Maryland must not exceed an annual harvest of 170,653 horseshoe crabs (2001 landings). This landing limit was maintained through addendum IV and VI from 2001-2012. The limit for Maryland in 2013 through 2020 was 255,980 male horseshoe crabs. A regulation protecting spawning horseshoe crabs was implemented in Maryland on January 31, 2017. The purpose of the action was to clarify that horseshoe crabs may be harvested from a vessel, but not from shore. Horseshoe crab commercial bait harvest regulations were the same in 2017 through 2021 (with the starting date varying by a few days in July).

The regulations in 2021 were as follows:

Quota:
- The annual total allowable landings of male horseshoe crabs for the commercial fishery was 255,980.
- No female harvest is permitted.

Season:
- May 1, 2021 to July 11, 2021:
  A person may catch or land horseshoe crabs outside of 1 mile of the Atlantic coast.
  A person may catch or land horseshoe crabs in Maryland's Coastal Bays and their tidal tributaries.
  A person may not catch or land horseshoe crabs within 1 mile of the Atlantic coast, or the Chesapeake Bay and its tidal tributaries.
- July 12, 2021 through November 30, 2021:
  A person may catch or land horseshoe crabs from the tidal waters of the state.
- December 1, 2021 through April 30, 2022:
  A person may not catch or land horseshoe crabs in Maryland.

Catch Limits:
- An individual may not land more than 25 male horseshoe crabs unless they are in possession of a valid horseshoe crab landing permit.
- May 1, 2021 through July 11, 2021: A permittee may not land more than 150 male horseshoe crabs per day.

- July 12, 2021 through November 30, 2021: A permittee may not land more horseshoe crabs than the amount specified on their permit.

The Fisheries

Since 1998, reported coastwide landings indicate more male than female horseshoe crabs were harvested annually. Several states have had sex-specific restrictions in place since 2012 to limit the harvest of females. The American eel pot fishery prefers egg-laden female horseshoe crabs as bait, while the whelk (conch) pot fishery is less dependent on females.

Maryland's commercial horseshoe crab harvest is caught primarily by trawl nets in the Atlantic Ocean. The trawl fishery accounted for 99% of the horseshoe crab harvest in 2021. Maryland had an unusually low harvest in 2015 (27,494 crabs), and has not harvested its full quota since 2012. There were no recreational landings of horseshoe crabs. In 2021, commercial harvest was 181,040 male horseshoe crabs (Figure 1).[5]

There are several companies along the Atlantic coast that process horseshoe crab blood. The scientific permits for biomedical use allow horseshoe crab collection during seasonal closures. Limulus Amoebocyte Lysate (LAL), extracted from horseshoe crab blood, is used to screen injectable drugs, biologics, medical devices, and raw materials for the presence of endotoxins and gram-negative bacteria. All crabs harvested for bleeding must be returned to the waters where they were caught within 48 hours. Crabs purchased from bait harvesters must be returned to the bait harvester after being bled. A chain of custody form accompanies all batches of horseshoe crabs. The number of crabs landed coast wide for biomedical bleeding (not bait) has been increasing in recent years (Figure 2).

Issues/Concerns

USFWS published a rule to list the red knot as a threatened species in December 2014. The primary threats to red knot in the mid-Atlantic region are climate change induced effects such as habitat impairment and loss, and asynchronous timing with food resources. Availability of horseshoe crab eggs, horseshoe crab harvest, and bleeding mortality data are of concern. The USFWS recognized the validity of the ARM framework to control horseshoe crab harvest and prevent harvest from being a threat to red knot. A concurrent factor is the presence of peregrine falcons, which prey on red knot. The presence of peregrine falcons can inhibit red knot foraging regardless of horseshoe crab egg abundance.[1] In addition, genetic variability in red knot body mass thresholds may be an important factor for their annual survival. A recent survey (January 2018) of red knots on their overwintering grounds in Chile indicated the population had declined to less than 10,000 birds, a 25% decline from 2017 and the lowest recorded number since the survey started in 2011.

Horseshoe crabs prefer to spawn on sandy beaches in protected areas like coves and bays. Shallow water areas of the Chesapeake Bay and Maryland and Virginia coastal bays are important nursery areas. The ASMFC Habitat Committee has identified threats to horseshoe crab spawning habitats. These threats include coastal erosion, shoreline development and stabilization, sea level rise, contaminants, oil spills, human disturbances, and excess nitrogen. Recommendations for counteracting the threats include identifying and protecting spawning/nursery areas and reducing human disturbances. Activities such as beach grooming and nourishment, all- terrain vehicles (ATV), and beach watercraft should be limited on horseshoe crab spawning beaches during the spawning season**.** Maryland DNR staff continue to work with staff from the Coastal Bays Program and Worcester County to show how soft shore stabilization can create or protect horseshoe crab spawning habitat.

The Virginia Polytechnic Institute trawl survey conducted along the mid-Atlantic Bight (Virginia to New York) is a critical component for determining the harvest level of horseshoe crabs under the ARM model but was discontinued in 2014 due to a lack of funding. In its place, the ASMFC board approved a composite trend index from Delaware and New Jersey fishery independent surveys. Although funding for the Virginia trawl survey was secured for 2016 through 2021, the status of funding remains tenuous.

Reductions in Mid-Atlantic harvest quotas, particularly in Delaware Bay, have redirected harvest to the New York and New England fisheries. Localized overharvest within these regions is possible meaning current harvest levels may not be sustainable.[2]

Figure 1. Maryland's commercial horseshoe crab landings and quota: 1998-2021.[5] The 2013-2021 quota was restricted to male horseshoe crabs (Maryland catch records).

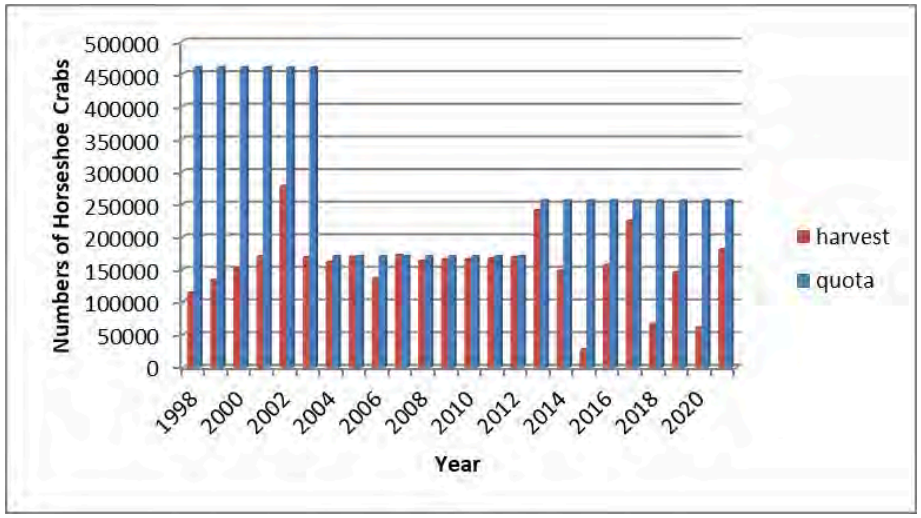
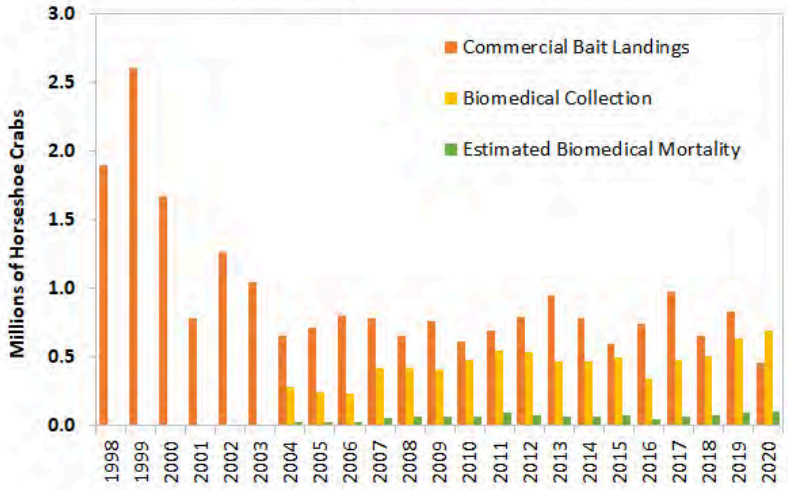


Figure 2. Horseshoe crabs bait and biomedical landings (ASMFC).



Please note the following details regarding biomedical collection numbers:

* Biomedical collection numbers, which are annually reported to the Commission, include all horseshoe crabs brought to bleeding facilities except those that were harvested as bait and counted against state quotas.
* Most of the biomedical crabs collected are returned to the water after bleeding; a 15% mortality rate is estimated for all bled crabs.

References

[1] Federal Register/Vol. 78, No. 189 /Monday, September 30, 2013 / Proposed Rules. Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Rufa Red Knot (*Calidris canutus rufa*). Pp 60024-60098.

[2] Atlantic States Marine Fisheries Commission. 2019. Horseshoe crab benchmark stock assessment and peer review report. Atlantic States Marine Fisheries Commission, Washington, DC. May 2019.

[3] Atlantic States Marine Fisheries Commission. 2021 review of the Atlantic States Marine Fisheries Commission fishery management plan for horseshoe crab (*Limulus polyphemus*): 2020 fishing year. Atlantic States Marine Fisheries Commission, Alexandria, VA. http://www.asmfc.org/species/horseshoe-crab

[4] Zimmerman, J., E. and D. Smith, S. Bennett. 2017. Horseshoe crab Spawning Activity in Delaware Bay: 1999-2017. Report to the Atlantic States Marine Fisheries Commission's Horseshoe crab Technical Committee.

[5] Doctor, S. 2022. Maryland's 2021 horseshoe crab (*Limulus polyphemus*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources Fisheries Service, Annapolis, MD.

1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table			
Problem Area	**Action**	**Date**	**Comments**
Strategy 1.1 Maryland and Virginia will protect the ecological role of horseshoe crabs by protecting horseshoe crab spawning areas and monitoring harvest.	1.1 Maryland and Virginia will prohibit the hand collection of horseshoe crabs from beaches during the peak time of shorebird migration, May 1-June 7.	1995	MD prohibited hand collection of HSCs between May 1 and June 7.
		1996	Based on spawning data, MD modified the restriction on hand collection of HSC to between April 1 and June 30 on Monday and Thursday only.
		1998	The CBP Horseshoe Crab FMP was adopted in 1994 but the coastal ASMFC requirements weren't adopted until 1998. Jurisdictions must now comply with all ASMFC HSC harvest restrictions.
		2001	NMFS established a HSC reserve in federal waters, having a 30-mile radius from the mouth of Delaware Bay.
		2009 Continue	MD COMAR 08.02.10.01.01 states that all persons are prohibited from catching or landing HSCs in state waters from December 1 to June 7, and catching or landing HSCs from the Chesapeake Bay and its tidal tributaries, or within 1 mile of the Atlantic coast or its coastal bays shoreline, from June 8 to July 12. Persons can collect crabs Monday thru Friday from July 13 to November 30. There are no recreational catch limits but a person must abide by the seasonal closures and the 25 crab/person/day limit if he/she does not have a permit**.** Exact dates for harvest vary annually.
		Continue	VA Chapter 4 VAC 20-900- restricts hand collection unless a person has a hand harvester license. 5 HSCs/person/day may be harvested for personal use without a license.
		2006	VA prohibits HSC harvest within 1,000 ft. of mean low water May 1 through June 7.
		2011	VA implemented a license and permit moratorium. Only commercial fishermen who held a HSC harvest permit prior to May 1, 2011 are eligible to purchase a permit after May 1, 2011.
		2017 to present	Maryland prohibits the harvest of horseshoe crabs from beaches beginning in January 2017. Horseshoe crabs must be harvested from a boat.
	1.2a Maryland will prohibit the scraping, trawling or dredging of horseshoe crabs between May 1 and June 7 within the Chesapeake Bay, coastal bay areas, and 1 mile of the Atlantic Coast.	1995	The time period recommended to prohibit the scraping, trawling, and dredging of HSCs within the Chesapeake Bay, Coastal Bays, and within 1 mile of the Atlantic coast, was changed from May 1 and June 7 to April 1 and June 30, based upon MD spawning survey data

		2004 2009 Continue Continue	Crabs harvested from the bait industry can be bled by the biomedical industry. These crabs must be returned to the bait harvester after being bled. April catch or harvest restriction was added to the spring fishery. MD COMAR 08.02.10.01.01 states that HSCs cannot be caught or landed in MD state waters from December 1 to June 7. This restriction includes a May 1 to June7 closure. Scientific collection permits (including biomedical bleeding) allow HSC collection during the fishery closure so long as crabs are released alive within 48 hours to waters where they were caught. HSCs are collected and reared as part of the education outreach program and is a tri-state endeavor. Dates vary annually. May 1 to July 9 harvest is allowed 1 mile off Maryland's Atlantic coast. Harvest is allowed in all tidal waters from July 10 to November 30. Harvest is Monday through Friday and female harvest is prohibited.
	1.2b Virginia will continue its ban on trawling within state waters.	1995	Virginia prohibits the use of trawls in Virginia's portion of the Territorial Sea.
	1.3 Virginia will prohibit a directed horseshoe crab fishery between May 1 and June 7, continue mandatory reporting in the conch dredge fishery, and monitor bycatch of horseshoe crabs.	1995 Continue	An ASMFC HSC FMP was adopted in 1998. Since then, additional harvest restrictions have been implemented as needed.
Strategy 2.1 Maryland and Virginia will coordinate with Delaware to develop a spawning stock census of horseshoe crabs that will serve as the basis for determining management recommendations as appropriate.	2.1 Maryland and Virginia will coordinate and implement a horseshoe crab spawning stock census in the Chesapeake Bay, coastal bays, and along the Atlantic coast.	1995 2002 Continue 2007 Continue 2008 Continue	An annual spawning stock survey was initiated from 1994 to 2000 in MD. MD's spawning survey is only in the Coastal Bays (not the Chesapeake Bay). The MD Coastal Bays HSC trawl survey has been conducted since 1990. The Delaware spawning survey provides data on assessing the status of the spawning population. From 1999-2017, there have been no significant detectable trends in HSC spawning activity. The Maryland Coastal Bays program began a volunteer spawning survey. Public reports of HSC spawning in the Chesapeake Bay are kept on file. The public can report sightings of horseshoe crabs spawning, or report tagged crabs, via the MDDNR horseshoe crab website. Adaptive Resource Management Modeling (ARM) is being used to determine the ecological interaction between HSCs and shorebirds, and the economic and biological value of HSCs to the commercial fishery and the biomedical industry. This approach was formally adopted by ASMFC Addendum VII in 2012. The process underwent an in depth review in 2016, and resulted in a proposal to draft an addendum. The addendum has been postponed until after the completion of a stock assessment in 2019. The biomedical industry is collaborating with the USFWS Coastwide Tagging Program for HSC. Annual total coastwide harvest by the biomedical industry is

			reported, and estimated mortality is calculated. The total estimated mortality from biomedical crabs was 47,765 crabs in 2016, with an estimated range of 16,937 to 96,545 crabs.[2]
		2019 Continue and refine yearly	MD DNR staff designed and implemented a web-based application where citizens can report spawning concentrations of horseshoe crabs. The information is then entered into a GIS system. The web-based application is available statewide.
Strategy 2.1 Continued	2.2 Maryland and Virginia will promote and encourage research on horseshoe crab estimates of population abundance, age and size composition, mortality estimates and migration.	Continue	CPUE data is collected from MD's offshore and coastal bay trawl survey, and blue crab summer trawl survey within the Chesapeake Bay. Sex data is collected from MD's spawning beach survey.
		Continue	A tagging program was initiated in 1995 to determine migratory patterns, identify stocks, and increase our understanding of the HSCs spawning behavior. USFWS currently directs the effort. Since 1999, over 300,000 horseshoe crabs have been tagged along the Atlantic coast.
		Continue	ASMFC coastal management actions include a mandatory monitoring program, tagging studies, spawning surveys, and egg surveys.
Strategy 3.1 Maryland and Virginia will monitor the commercial and medical harvest of horseshoe crabs to improve the quality of data obtained from the commercial fishery.	3.1a Maryland will require horseshoe crab harvesters to provide monthly reports on the size of harvest, area of collection, gear usage, and any other information the Department of Natural Resources deems necessary.	1995 Continue	Reporting was implemented on January 29th, 1996. A permit system is currently required, and used to monitor commercial harvest.
		2000	ASMFC instituted a 25% reduction in horseshoe crab bait landings using 1995-1997 as the reference period.
		2004	MD has implemented additional restrictions based on ASMFC Addendum III. MD landings limited to 170,653 lbs. annually, based on 2001 landings. MD began implementing a 1:1 male: female harvest ratio issued by public notice. Saturday and Sunday harvest closure. Limit of 100/person/day with permit 1 mile off Atlantic coast from Jun 8 to Jul 10. From Jul 13 thru Nov 30 in all waters, harvest is quota with permit, or 25/person/day without a permit. Permittee's catch limit is based on the ratio of reported 1996 landings applied to total annual allowable landings for the present year.
		2006 Continue	ASMFC Addendum IV changed the start of harvest closure from May 1 to January 1. This provision was to expire in 2008, but was continued through 2009. All HSC supplied to the bait fishery is included in that state's allowable harvest. The biomedical industry will make available all HSC that die prior to live release to the bait fishery.
		2004 Continue	HSC annual bait fishery quota has been 170,653 HSCs since 2004**.** Harvest closure was December 1 – March 31 and May 1 - June 7. Harvest is allowed >1

			mile offshore during April 1 – 30 & June 8 - 30. Harvest is allowed from July 1 – November 30 in all MD tidal waters.
		2008	MD changed the HSC harvest ratio to 2:1 male: female ratio (issued by public notice**)**.
		2009 Continue	Biomedical industry is allowed to land male HSCs for bleeding during the May 1 to June 7 harvest closure so long as the crabs are released within 48 hours. Spring harvest closure was extended to include April 30. A "chain of custody" must be documented for every batch of HSCs received.
		2010 Continue	Harvesters are required to submit monthly catch logs. Commercial harvest reports must be submitted to MD DNR Fisheries Service within 10 days after the end of the month being reported, after which the report is late.7
		2011	Harvesters began importing Asian horseshoe crabs for bait.
		2013	Maryland banned the importation of Asian horseshoe crabs.
	3.1b Maryland will determine if a special permit to harvest horseshoe crabs is necessary, after evaluating the new federal reporting system and the results of the monthly reports	1995 2001 Continue	MD requires a special HSC permit to land HSCs. ASMFC allows state-to-state transfer of quotas.
	3.2 Virginia will continue their mandatory reporting procedures implemented in January 1993.	1993 Continue	Reporting was implemented in January of 1993. VA has a commercial quota based on coastal reference period.
		2000	The ASMFC instituted a 25% reduction in horseshoe crab bait landings using 1995 to 1997 as the reference period.
		2006	ASMFC Addendum IV changed the start of harvest closure from May 1 to January 1 through 2008. It required that Virginia trawl harvest not exceed a certain percentage from a specified area, and must maintain at least a 2:1 male: female harvest ratio to protect the Delaware stock. Commercial quota is 152,495 HSCs. Quota can be transferred from other jurisdictions with a combined cap.
		2016	Virginia HSC harvest east of the COLREGS line is 81,331 male crabs.
	3.3. Maryland and Virginia will survey American eel harvesters, and their use of horseshoe crabs by sex for bait.	1995 2000	No longer an issue. Both eels and horseshoe crabs are managed through ASMFC coastal FMPs.
Strategy 4.1.1 The jurisdictions will define and protect	4.1 Maryland and Virginia will initiate a study to delineate the geographic distribution of horseshoe crab	Continue	A HSC hotline and spawning beach survey was developed in 1994 to delineate spawning habitat in Maryland. MD DNR currently has a horseshoe crab webpage that invites people to help identify spawning habitat, and report

horseshoe crab spawning areas that are used by migrating shorebirds.	spawning habitat in the Chesapeake Bay and coastal bays, if funding is available.		tagged horseshoe crabs. The webpage includes both phone numbers and email addresses for reporting information.
		Continue	MD DNR Coastal Bays Program and Worcester County staff have cooperative projects that display shoreline stabilization using soft shoreline designs to create or protect HSC spawning habitat.
		2019 Continue	MD DNR staff designed and implemented a web-based application where citizens can report spawning concentrations of horseshoe crabs. The information is then entered into a GIS system. The web-based application is available statewide.
	4.2 The jurisdictions will promote research to define the water quality requirements for horseshoe crabs.	2010 Continue	The Maryland Coastal Bay volunteer spawning survey began recording temperatures to understand the horseshoe crab spawning behavior in the Maryland Coastal Bays.
	4.3 The jurisdictions will continue to work with the Chesapeake Bay Program, the Coastal Bay Initiative, and water quality improvement goals for the Bay and coastal areas.	Continue	The Chesapeake 2000 Agreement commits to improving habitat and water quality for living resources in the Bay. The 2000 agreement was replaced with the Chesapeake Watershed Agreement in 2014. The Comprehensive Coastal Management Plan (CCMP) includes strategies and actions to improve Coastal Bays water quality and habitat conditions**.** In 2017, the Coastal Bays report card indicated a B- grade, the best improvement over 32 years.

Acronyms

ASMFC – Atlantic States Marine Fisheries Commission
CBP – Chesapeake Bay Program
COLREGS – International Regulations for Preventing Collisions at Sea
COMAR – Code of Maryland Regulations
CPUE – Catch per Unit Effort
FMP – Fishery Management Plan
HSC – Horseshoe Crab
MD – Maryland
MD DNR – Maryland Department of Natural Resources
NMFS – National Marine Fisheries Service
USFWS – United States Fish and Wildlife Service
VAC – Code of Virginia

2021 Maryland FMP Report (December 2022)
Section 13. King Mackerel (*Scomberomorus cavalla*) and Spanish Mackerel (*Scomberomorus maculatus*)

Spanish mackerel and king mackerel migrate between Florida and New York, and are found in Maryland and Virginia's waters in the warmer months. Spanish mackerel generally arrive in the Chesapeake Bay in late spring, giving anglers an opportunity to catch them. King mackerel are less common seasonal visitors to Maryland's coastal waters. King mackerel and Spanish mackerel are managed under the same plan within the Chesapeake Bay. Looking at records from 1986 to 2024, Spanish mackerel had the greatest recorded recreational harvest in 2021 in Maryland. A commercial catch limit was in effect in Maryland for Spanish mackerel starting July 9, 2021. Spanish mackerel and king mackerel are currently not overfished or experiencing overfishing based on the South Atlantic coastal stock assessments. [1,2]

Chesapeake and Atlantic Coast Fishery Management Plan (FMP)

The Chesapeake Bay and Atlantic Coast King and Spanish Mackerel Fishery Management Plan (CBK/SM FMP) was adopted in 1994. The plan follows the coastal management requirements. The CBK/SM FMP was reviewed in 2014 and was determined to be an appropriate framework for managing mackerel in Maryland. Spanish mackerel are managed jointly under the Atlantic States Marine Fisheries Commission's (ASMFC) 1990 FMP for Spanish mackerel, and the federal Coastal Migratory Pelagics (CMP) FMP adopted in 1983 by the South Atlantic Fishery Management Council (SAFMC), which also includes management of king mackerel. Since 1985, 26 amendments have been adopted by the SAFMC making changes to the allocation of commercial quotas, changes to at-sea transfer rules, and changes that increase the total allowable catch of Spanish mackerel. Amendment 6 modifies the zones and trip limits under amendment 26 for king mackerel in the federal waters of the South Atlantic, effective September 11, 2019. Amendment 6 requires no changes to Maryland and Virginia fisheries. For specific details on each of the amendments, go to:
https://safmc.net/amendments/cmp-amendment-6/

Atlantic coastal states comply with the provisions of the 1990 Spanish Mackerel ASMFC FMP, Omnibus Amendment (2011) and Addendum I to the Omnibus Amendment (2013) by implementing creel limits, size limits, and seasonal closures that closely mirror the SAFMC CMP FMP requirements. To view ASMFC FMP documents, go to: http://www.asmfc.org/species/spanish-mackerel.

Stock Status

There is no formal stock assessment for either mackerel species in the Chesapeake Bay. A stock assessment conducted by the Southeast Data, Assessment, and Review Process (SEDAR 28) in 2012 (revised in 2013) concluded that the Spanish mackerel Atlantic stock is not overfished, and overfishing is not occurring. The coastal stock was overfished in the 1980's and early 1990's, which led to harvest control regulations. Management measures have been successful at rebuilding the Spanish mackerel stock. The ratio of biomass to biomass at maximum sustainable yield (Bmsy) has been increasing.[3]

A stock assessment for the Atlantic king mackerel migratory group was completed in 2014 (SEDAR 38), and concluded that the stock is not overfished, and overfishing is not occurring. However, there is some concern over low recruitment and possible northward shifts in distribution.[2]

Current Management Measures

The coastal annual catch limit (ACL) for Spanish mackerel was set at 6.063 million lbs under CMP Framework Amendment 1 to the federal FMP (2014). Fifty-five percent of the ACL is allocated to the coastal commercial fishery, and 45% is allocated to the coastal recreational fishery. The commercial portion of the ACL was further divided with 19.9% going to the northern fishing area and 80.1% to the southern fishing area (Amendment 20b, 2014). The north-south split occurs at the South Carolina-North Carolina border. King mackerel are also managed under an ACL, with an annual commercial quota. Although the Atlantic king mackerel management area extends to the Mid-Atlantic region, the SAFMC is responsible for providing management oversight on catch and bag limits for the recreational fishery, and catch, gear and seasonal limits for the commercial fishery.

Following public hearings, the ASMFC approved an omnibus amendment for spot, seatrout, and Spanish mackerel in August, 2011. The amendment includes an update to the coastal plan, and includes commercial and recreational management measures and recommendations, adaptive management options, *de minimis* thresholds and exemptions, monitoring recommendations, and requires each jurisdiction to submit an implementation plan and annual compliance report. [4,5] The amendment also requires recreational fishermen to land their catch with the head and fins intact. Maryland changed its regulations in 2012 to comply with the omnibus amendment.

On July 9, 2021 a catch limit was established that restricted commercial landings to 500 lbs of Spanish mackerel, per vessel, per day or trip to prevent going over the quota. All commercial Spanish mackerel fisheries closed from November 16, 2021 to

December 31, 2021 through a public notice and reverted back to the original regulations on January 1, 2022.

The Chesapeake Bay jurisdictions manage Spanish mackerel through size and creel limits, as well as closures consistent with federal management measures. All states from New York to Florida implemented the requirements of the 2011 Omnibus Amendment to the Interstate Fishery Management Plans for Spanish Mackerel, Spot, and Spotted Seatrout. Maryland and Virginia require a 14 inch minimum total length limit, with a creel limit of 15 Spanish mackerel for recreational fishermen and a 3,500 lbs per trip limit for commercial fishermen. The king mackerel size limit is 27 inches in Virginia, with a creel limit of 3 fish for recreational fishermen in Virginia. Maryland has not developed regulations for king mackerel because they are rarely encountered in Maryland state waters. Commercial harvest reporting is required. Cull panels are used to reduce bycatch from pound nets set in the Potomac River by the Potomac River Fisheries Commission (PRFC). PRFC regulations for both species mirror those of Maryland.

The Fisheries

In most years, the estimated recreational harvest of Spanish mackerel is greater in Virginia than in Maryland (Figure 1). Catch estimates in the recreational fishery are imprecise, with proportional standard errors in excess of 50 for most years in both Maryland and Virginia. In all years, commercial landings of Spanish mackerel from Virginia waters greatly exceeded those from Maryland (Figure 2). Annual recreational harvest estimates for Spanish mackerel have been highly variable for both states, ranging from zero to 718,353 lbs in Virginia, and zero to 251,273 lbs in Maryland.[6] Maryland had a record-setting recreational harvest in 2021. Over the past ten years, annual commercial landings for Spanish mackerel have ranged from zero to 213,290 lbs in Virginia, and zero to 16,209 lbs in Maryland.[2] Maryland's commercial landings for 2021 are 6,006 lbs.

Issues/Concerns

The 2014 Review of the ASMFC FMP for Spanish mackerel recommended additional research and monitoring. High priority recommendations included collecting basic fisheries data for better stock assessment accuracy; developing methods for fishery-independent monitoring; determining better estimates of recruitment, natural and fishing mortality rates and stock size, and implementing ecosystem-based management.

Figure 1. Estimated recreational harvest of Spanish mackerel from Maryland and Virginia, 1986-2021.

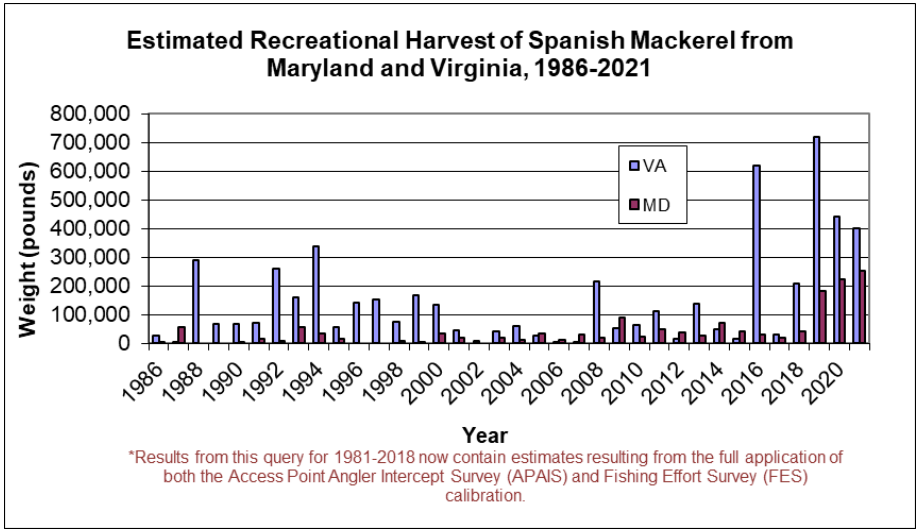
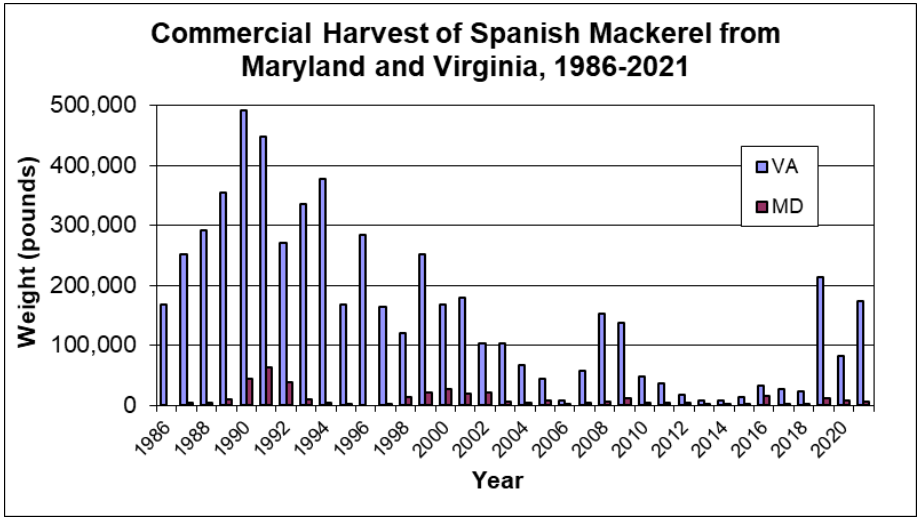


Figure 2. Commercial harvest of Spanish mackerel from Maryland and Virginia, 1986-2021.



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[3] SEDAR. 2012. SEDAR 28 – South Atlantic Spanish mackerel Stock Assessment Report. SEDAR, North Charleston SC. 444 pp. available online at: http://www.sefsc.noaa.gov/sedar/Sedar_Workshops.jsp?WorkshopNum=28

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[5] Messer, K.M. 2022. Maryland Spanish Mackerel (Scomberomorus maculatus) Compliance Report to the Atlantic States Marine Fisheries Commission – 2021.

[6] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, Marine Recreational Information Program October 27, 2022.

[7] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, commercial harvest query October 27, 2022.

1994 Chesapeake and Atlantic Coast King and Spanish Mackerel Management Plan Implementation Table			
Section	**Action**	**Date**	**Comments**
Stock Status	1.1.1 A) Virginia will enforce a 14" TL minimum size limit and a 10 fish/person/day bag limit for Spanish mackerel.	1991 Continue	Minimum size and creel limits in place. Creel limit increased to 15 fish/person/day. VA implemented a commercial limit of 3,500 lbs in 2012. Spanish mackerel must be landed with head and fins intact.
	1.1.1 B) Maryland will enforce a 14" TL minimum size limit for both the recreational and commercial fisheries, and a 10 fish/person/day bag limit for Spanish mackerel.	1993 Continue	Minimum size and creel limits in place. Creel limit increased to 15 fish/person/day. MD has a commercial limit of 3,500 lbs of Spanish mackerel per vessel per day, which was implemented in 2012. Spanish mackerel must be landed with head and fins intact.
	1.1.2 A) Virginia will enforce a 5 fish/person/day bag limit for king mackerel.	1991 Continue	Minimum size and creel limits in place. Creel limit reduced to 3 fish/person/day.
	1.1.2 B) Maryland will enforce a 5 fish/person/day bag limit for king mackerel.		MD has not developed regulations for king mackerel, since most of the catch is outside state waters. Fishermen must abide by the limits imposed in the EEZ.
	1.1.3. Virginia and Maryland will enforce a 20" FL or 23" TL minimum size limit for king mackerel.		Minimum size limit of 27" established in VA.
	1.1.4. Virginia and Maryland will close their respective commercial and recreational fisheries for king and Spanish mackerel, when such closures are in effect in Federal waters.	1995	Closures will be in compliance with SAFMC recommendations.
Monitoring catch and quotas, and research needs.	2.1.1. Virginia and Maryland will require mandatory reporting of commercial landings	Continue	Both states are in compliance with reporting requirements.
	2.1.2. Virginia and Maryland will supplement the Marine Recreational Statistics Program. MD will require charter boat logbooks.	Continue	Coastal charter boat logbook system was improved in 1994. Improvements in estimating recreational harvest are in progress under the NOAA Marine Recreational Information Program (MRIP)
	2.1.3. Jurisdictions will support stock assessment research for mackerel stocks.	Continue	VA samples Spanish mackerel for length and weight. The ASMFC omnibus amendment was approved in 2011, and was implemented July 1, 2012. The amendment includes monitoring and management recommendations. The most recent stock assessment for the south Atlantic stock of Spanish mackerel was completed in December of 2012 and revised in 2013. The next stock assessment is scheduled for 2020. The King Mackerel Stock Assessment Report was completed in August 2014 for the South Atlantic and Gulf of Mexico.
Waste/sublegal bycatch and hook and release mortalities	3.1.1. Virginia will evaluate the use of escape panels as a means of reducing undersized bycatch. VA will enforce a 2 7/8" minimum mesh size for gill nets.	Completed	VA conducted studies on escape panels in pound nets, and found they were successful at reducing bycatch.

	3.1.2. Jurisdictions will support angler educational programs.	Continue	In 2008, Project FishSmart was organized by UMCES to develop a process for developing a consensus position on fisheries management options by a stakeholder group of biologists, environmental organizations, tackle shop owners, charter boat operators, anglers, commercial fishermen, and tournament organizers. The pilot project species was King Mackerel, and the goal of the project was to prevent overfishing, and preserve a year-round fishery, with recommendations being adopted Nov 7, 2008. A report was submitted to the South Atlantic Fishery Management Council that recommended three options for consideration (UMCES, 2008), which were in its public scoping document. No new efforts have been focused on mackerel, but the Bay jurisdictions continue angler education whenever possible.
	3.1.3. Virginia will monitor bycatch sold as crab bait from the pound net and haul seine fisheries.	1995	
Habitat Issues	4.1.1. Jurisdictions will continue to work with the Chesapeake Bay Programs, the Coastal Bays initiative, and water quality improvement goals for the Bay and coastal areas.	Continue Continue	The CBP completed a Chesapeake Bay Watershed Agreement in 2014, which sets new goals and outcomes for restoration and protection of the Chesapeake Bay, and its watershed. A copy of the agreement can be found on the CBP website at http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf The Agreement has fish habitat, forage fish, SAV and water quality outcomes that when reached, will enhance habitat and prey availability for adult Spanish mackerel. Bay jurisdictions developed two-year work plans for each outcome in 2016-2017 and 2018-2019.

Acronyms

ACL – Annual Catch Limit
ASMFC – Atlantic States Marine Fisheries Commission
CMP – Coastal Migratory Pelagics
CBP – Chesapeake Bay Program
EEZ – Exclusive Economic Zone
MRIP – Marine Recreational Information Program
NOAA – National Oceanic and Atmospheric Administration
PRFC – Potomac River Fisheries Commission
SAFMC – South Atlantic Fisheries Management Council
SAV – Submerged Aquatic Vegetation
SEDAR – South East Data, Assessment, and Review Process
UMCES – University of Maryland Center for Environmental Studies

2021 Maryland FMP Report (December 2022)
Section 14. Eastern Oyster (*Crassostrea virginica*)

A stock assessment update was conducted in 2021.[1] Six of the 36 areas were being fished above the fishing limit (lower Choptank River, St. Mary's River, upper and lower Tangier Sound, Nanticoke River, and Big Assessmex River). The 2021 update indicated that two areas had market-sized oyster abundance below the abundance biological reference limit: Lower Chester River and Upper Chester River. The declines in these areas are most likely due to environmental causes and not harvest since these areas include sanctuaries (69% and 100%, respectively, are sanctuary areas) and were not estimated to be experiencing overfishing in the most recent two years.

Based on the results of the 2021 oyster stock assessment update, the Maryland Department of Natural Resources (MD DNR) did not alter harvest limits for the 2021-2022 season. Harvest limits continued to be set at the lower limits established in 2019.

Maryland remains committed to restoring five oyster tributaries to meet the 2014 Chesapeake Bay Watershed Agreement oyster outcome.[2] Restoration work continued in the Harris Creek, Little Choptank, and Tred Avon sanctuaries in 2021. The Tred Avon River Sanctuary received its last initial seeding in 2021, thus making it Maryland's third tributary to be initially restored. Restoration began in 2021 for the St. Mary's and Manokin sanctuaries.

The Oyster Advisory Commission (OAC) provided MD DNR with an approved package of recommendations.[3] This package was voted on by the commission on November 8, 2021 and received 80% agreement among the commissioners. The 19 recommendations in the package are based on options that were rated with an agreement level of 75% or higher. OAC members considered more than 100 options when developing the list of consensus recommendations. An amendment to the 2019 Maryland Chesapeake Bay Oyster Management Plan is being developed currently to address the recommendations.

The second Five Year Oyster Management Review report was published in 2021.[4] This report covers the 2016-2020 time period. The first report, published in 2016, reviewed 2010-2015 information. This report uses available information to describe the current status of oyster sanctuaries, Public Shellfish Fishery Areas (PSFAs), and Maryland's aquaculture industry 10 years after the management plan was adopted. Their effectiveness is measured against the 12 objectives of the 2010 proposal with the overall goal to restore the ecological function of oysters and to enhance the commercial fishery for its economic and cultural benefits. The management plan adopted in 2010 sought to resolve the dual goals of ecological and economic restoration by creating distinct management areas each with its own objectives – sanctuaries, PSFAs, and aquaculture areas.

Chesapeake Bay Oyster Management

Fishery managers began a more comprehensive and coordinated management of oysters throughout the Chesapeake Bay with the adoption of the Chesapeake Bay Oyster Management Plan (1989), subsequent revisions in 1994 and 2004, and an amendment in 2010. In addition, efforts to rebuild the Chesapeake Bay's native oyster resource have been directed by commitments in the Chesapeake 2000 Agreement,[5] 2009 Programmatic Environmental Impact Statement,[6] 2010 Maryland's 10-Point Oyster Restoration Plan,[7] and the 2014 Chesapeake Bay Watershed Agreement.[2]

Since the oyster management plan addresses more than just the public fishery, the plan uses a more comprehensive title, the "Maryland Chesapeake Bay Oyster Management Plan," but is still considered a fishery management plan.

The Maryland Chesapeake Bay Oyster Management Plan (OMP) was adopted in 2019.[8] The purpose of the 2019 OMP is to provide both a general framework and specific guidance for implementing a strategic, coordinated, multipartner management effort. Representatives from MD DNR developed the plan with stakeholder input from the oyster industry, environmental groups, academia, federal agencies, and the general public. The plan defines multiple strategies for protecting, rebuilding, and managing the native oyster population. Two source documents provided information for this plan: the Oyster Management Review 2010-2015; and a stock assessment of the Eastern Oyster, *Crassostrea virginica*, in the Maryland waters of the Chesapeake Bay.[9,1]

The goal of the OMP is to conserve, protect, and where possible, rebuild oyster populations to fulfill their important ecological role and to support the culturally significant oyster fishery and industry throughout the Maryland portion of the Chesapeake Bay. Fifteen objectives outlined in the OMP were categorized as overarching oyster resource objectives, sanctuary objectives, public fishery objectives, and aquaculture objectives. The OMP lists 22 strategies and 82 actions to achieve its goal and objectives. These strategies and actions include: adaptive management, salinity influence on management, substrate usage, utilizing stock assessments and biological reference points in management, maintaining a sanctuary program, supporting citizen based oyster gardening restoration efforts, identifying productive oyster habitat, utilizing different public fishery management areas and replenishment plantings, protecting public health, recreational harvesting, supporting aquaculture, continuing and enhancing monitoring activities, promoting and

supporting socioeconomic benefits, strengthening enforcement, and protecting ecological services of oysters.

Stock Status

The 2021 Fall Survey was conducted from October 5, 2021 to November 31, 2021 throughout the Maryland portion of the Chesapeake Bay and its tributaries, including the Potomac River.[10] A total of 352 samples were collected from 278 oyster bars. Locations monitored included natural oyster bars, oyster seed production areas, seed and shell planting sites, and sanctuaries.

Among the environmental factors affecting oyster populations, freshwater streamflow is critical as it controls the salinity regime of the bay, which in turn influences spatset, diseases, mortality, and growth of oysters. For 2021, the annual average freshwater input was close to normal for the second consecutive year, following two years of record high streamflows.

The spatfall intensity index of 43.9 spat/bushel (bu) was less than half of the previous year's index but almost double the 37-year median and the eighth highest of the time series. The spatset was well distributed, with good recruitment occurring in the lower Bay, especially the Tangier Sound region and the Choptank and Little Choptank regions. The tributaries with the highest spat counts were the St. Marys River, followed closely by Broad Creek. Also noteworthy was the spatset in the Eastern Bay region. Although modest in scope, it was a considerable improvement for this once-productive area that has experienced repeated recruitment failures in recent years. In contrast, few or no spat were found along the western shore to the north of Cove Point, the upriver half of the Potomac oyster growing region, and the entire mainstem and tributaries north of the Chesapeake Bay Bridge.

Although showing a slight uptick from the previous two years, disease levels remained among the lowest on record for the 32-year time series. Dermo disease remained widely distributed throughout the oyster-growing waters of Maryland, being found on 93% of the sentinel bars. The 2021 mean prevalence (36%) increased marginally from the previous year (33%), but was the third lowest of the time series and substantially below the 32-year average of 62.7%. The mean infection intensity for dermo disease (1.2 on a scale of 0-7) was almost half of the long-term average and the fourth lowest of the time series, just slightly higher than the record low (1.0) of 2019 for the lowest average intensity. The geographical distribution of MSX expanded somewhat during 2021, but remained restricted to the high salinity of the lower Chesapeake Bay and the Tangier Sound region. The MSX disease mean prevalence (0.4%) on the disease index bars was only a slight increase over the previous three years, which had the lowest annual means in fall survey records over the past 31 years. Six oysters from five sites of the 1,290 oysters examined from the disease index bars were infected with MSX disease. MSX was also found in two additional oysters at two supplemental sites in the lower Chesapeake Bay and Tangier Sound.

The baywide observed mortality index was 6.0%, the lowest of the 37-year record. This was the 18th consecutive year that the mortality index was below the long-term average. A residual of higher observed mortalities from the major mortality event in 2020 persisted in the upper St. Mary's River, including the oyster sanctuary. Moderate mortalities were also observed in the upper reaches of a few other tributaries. Aside from these areas, regional average observed mortalities were extremely low. For example, Tangier Sound, typically a higher mortality area, experienced a remarkably low observed mortality for the third year in a row, averaging 4.6%.

The 2021 oyster biomass index of 2.69 represents a 36% gain of this index from the previous year, ranking it highest in the 29-year time series. The combined increases in both the number and size of oysters, especially from the strong 2020 recruitment event, accounts for this improvement in the biomass index.

Oyster larvae require a hard substrate to settle on. The Cultch Index is a relative measure of oyster habitat consisting of both live and dead oysters plus loose shell combined. The 2021 three-year rolling average of the cultch index was 0.79 bu/100 feet., somewhat lower than the 17-year average of 0.89 bu/100 feet. Some individual bars showed steep declines in recent years. Of the 53 bars used in this analysis, 31 (58%) had standardized volumes that were more than 25% below their respective 17-year averages. Strong regional differences in the cultch index were evident. The areas with the lowest cultch included most of the mainstem of the Bay, followed by the combined Chester River/Eastern Bay region. The highest regional cultch indices were in areas with more favorable oyster recruitment and consequent addition to cultch, specifically the Tangier Sound and Choptank River regions.

Within 31 sanctuaries, a total of 86 oyster bars were sampled during the 2021 Fall Survey to evaluate the status of their oyster populations. Trends in recruitment, disease, and mortality were in keeping with the baywide results. A disease/mortality/biomass index bar is located within each of 13 sanctuaries. In addition, seven supplemental disease sites are located in six additional sanctuaries. Dermo disease prevalences and intensities were well below long-term averages. Dermo levels trended somewhat higher in the sanctuaries than in adjacent harvest areas, likely because the sanctuaries had a higher proportion of larger, older oysters, which can accumulate higher burdens of the parasites. Despite the slightly higher dermo levels, observed mortality rates in the sanctuaries were comparable to those of harvest areas and continued to be markedly lower than the long-term average. Low prevalence of MSX disease was detected at two of the supplemental disease sites

within sanctuaries but not in the priority sanctuaries, as well as at five disease bars in open harvest areas. The 2021 average biomass index in the sanctuaries was considerably higher (+67%) than the baywide 29-year average, indicating population growth over time. Similarly, there was a substantial improvement (+118%) between the 2021 average biomass index and the long-term average in the open harvest areas. These increases were largely driven by the strong recruitment event of the previous year. As a result, the average biomass per index bar in 2021 was 8% higher in the open harvest areas than in the adjacent sanctuaries.

The priority restoration sanctuaries were compared with adjacent open areas. The restoration sanctuaries had generally higher recruitment than their adjacent open areas, aside from the Broad Creek harvest area. Recruitment within four of the five restoration sanctuaries - Harris Creek, Tred Avon, Little Choptank, and St. Mary's - was well above their long-term averages. The exception was the Manokin Sanctuary and its adjacent harvest area in mid-Tangier Sound, both which had below normal recruitment. The highest spat count of any of the comparison areas was in the St. Mary's Sanctuary, which averaged 412 spat/100 feet tow and was eight times as high as the open area. The average number of adult (small and market) oysters per 100 feet tow in the priority sanctuaries was consistently higher than in adjacent harvest areas, except for Broad Creek (omitting Royston Bar). Disease and mortality trends were similar to the broader findings above, apart from an elevated mortality rate in the St. Mary's Sanctuary. Cultch generally was at lower densities in the open harvest areas than the sanctuaries, except for Broad Creek (omitting Royston Bar).

Current Management Measures

There are three concurrent approaches to managing oysters in the Chesapeake Bay: ecological restoration, a sustainable public fishery, and aquaculture. Ecological restoration will meet the goal of the 2014 Chesapeake Bay Watershed Agreement to restore oysters to 10 tributaries by 2025 (five each in Maryland and Virginia). Harris Creek was selected as Maryland's first restoration area. Initial restoration efforts (reef construction and seeding) in Harris Creek were completed in 2015, with 348 acres planted with oyster seed or substrate with oyster seed. In 2020, the last of the planned second spat-on-shell planting restoration occurred. All reefs are now at least six years old and have been monitored to determine if restoration criteria is met. Ninety eight percent of reefs are meeting threshold restoration criteria for density and biomass six years after restoration.[9]

The Little Choptank River was selected as Maryland's second priority area for targeted oyster restoration with a goal of 440 acres. In 2017, the target restoration goal was reset at 357.8 acres, which corresponds to 52% of the restorable bottom. In 2020, the sanctuary received its last initial planting thereby making it Maryland's second tributary to be initially restored. The river will continue to receive its planned second seeding in future years as well as monitoring. To date, 100% of the six year old reefs are meeting the threshold restoration criteria for density and biomass.

The Tred Avon River was selected as Maryland's third area for oyster restoration with a goal of 130 acres (51.7% of currently restorable oyster habitat). In 2021, the sanctuary received its last initial planting thereby making it Maryland's third tributary to be initially restored. The river will continue to receive its planned second seeding in future years as well as monitoring.

The upper St. Mary's River was selected as the fourth area for oyster restoration with a goal of 60 acres to restore (85% of its currently restorable oyster habitat). In 2021, oyster spat-on-shell was planted on 15 acres and stone substrate was placed as a reef base on eight acres. It is expected that all initial restoration will be completed in 2022.

The Manokin River Sanctuary was selected as the fifth area for oyster restoration with a goal of 441 acres of restoration (75% of its currently restorable oyster habitat). In 2021, oyster spat-on-shell planting began on the seed-only restoration sites. In future years, ongoing spat-on-shell planting and substrate placement will occur.

Maryland's oyster harvest has ranged from 107,150 to 545,873 bu since 2010. Historically, the annual harvest averaged 2.5 million bu (1920-1985; prior to oyster disease greatly impacting the population) and 250,000 bu (1986-2010) (Figure 3). The harvest for the 2021-2022 season was 545,873 bu, a 57% increase from the previous season and the highest in over 35 years since the 1986-1987 season (Figure 3). Oyster surcharges also increased to 1,230, the highest number ever issued, representing the most effort since at least 2000 when tracking of surcharges began. The dockside value for the 2021-2022 season was $21.5 million, more than double that of the previous season.

In the 2021-2022 season, power dredging accounted for 48% of the landings, primarily from the Lower Eastern Shore and Choptank regions. Patent tongs were the second dominant gear type, harvesting 30% of the total. The Tangier Sound region was by far the leading production area with 68% of Maryland landings, primarily from upper and lower Tangier Sound. The Patuxent region followed with 8% of the landings, followed by Broad Creek with 6%.

Harvest season, workday and workweek lengths, regional gear restrictions, a three inch cull size, and daily catch limits by gear type are enforced for the public fishery. The MD DNR began implementing a procedure for tagging each container (bushel) of oysters during the 2011-2012 oyster season. Tagging procedures follow the

requirements of the National Shellfish Sanitation Program (NSSP) to protect human health.

In order to support the continued development and sustainability of shellfish aquaculture businesses, MD DNR has implemented numerous policies and programs to support shellfish aquaculture operations, including the establishment of financing, education and outreach, and training programs for prospective and existing industry members. While the industry as a whole experienced significant production and market challenges due to both ecological and societal factors from 2018 through 2021, the interest and investment in shellfish aquaculture, and in the production of farm-raised shellfish from leases has remained on an upward trajectory into and through 2022. Two of the most successful of these initiatives have been a Remote Setting and Training Program that provides leaseholders with an opportunity to cost-effectively produce oyster seed for planting on their leased areas, and partnership with the Maryland Agricultural & Resource-Based Industry Development Corporation (MARBIDCO) to provide low-interest loan and grant opportunities to shellfish leaseholders to finance various components of their lease operation costs.

As of December 31, 2021, there were a total of 465 shellfish aquaculture leases on 7,502 acres in Maryland. Submerged land leases account for 78% (362) of all leases and 92% (6,933 acres) of total lease acreage. The remaining leases are water column leases. Since 2010, the number of annual lease applications has varied from year to year, ranging from 14 to 74, and the Department has issued dozens of Shellfish Nursery Permits to allow for shellfish larvae and seed culture. A total of 589 shellfish lease applications have been received by the MD DNR since the modern leasing program was launched in Fall of 2010. From a humble 22,197 bu harvest in the first full year of monthly harvest reporting in 2013, the annual farm-raised shellfish harvest in Maryland more than quadrupled to just over 90,000 bu for 2021, the strongest production year since inception of the "modern" leasing program. These businesses continue to plant millions of oysters in the Chesapeake Bay and its tributaries annually, creating environmental benefits and economic activity while generating a sustainable, local food source.

In 2021, the Potomac River Fisheries Commission’s Oyster Management Reserve Program (OMR) contracted and purchased approximately 6,000 bu of James River Seed, which were planted on 12 acres on Cobb Island Bar. The OMR designated bar, Ragged Point, was open for harvest and approximately 569 bu of market size oysters were harvested.

For the wild oyster fishery, 10,000 bu of James River oyster seed was planted on 33 acres of Lower Cedar Point in May 2021. On the Special Management Area of Knott's Hollow, approximately 40 million diploid spat on shell were planted on eight acres in July 2021.

Citizen Involvement

The Marylanders Grow Oysters (MGO) program (https://dnr.maryland.gov/fisheries/pages/mgo/index.aspx) engages waterfront property owners in growing young oysters in cages suspended from private piers. The young oysters are protected during their first year, and then planted on local sanctuaries. The program has planted about 10 million oysters in sanctuaries since it began in 2008, and has grown from about 850 cages the first year to over 7,300 cages in 2017. The program includes approximately 1,500 growers from 25 tributaries. Additionally, over 2,000 school students through educational programs in 21 different Maryland schools are involved in some aspect of oyster gardening as part of their curriculum. The 2020-2021 MGO program distributed 1,506 bags of spat to 33 groups in 25 tributaries.

Issues/Concerns

A major issue for oyster recovery is the continued degradation and loss of habitat. Silt, even just a minor amount, degrades shell habitat and can impede spat set. Shells can settle into the bottom over decades of time and be lost. Additionally, shells can be lost through erosion-degradation due to chemical processes or biological factors such as boring sponges. A healthy and robust oyster resource in the Chesapeake Bay relies on appropriate substrate for the setting of young oysters. The preferred substrate, natural oyster shell, is scarce, and there is not enough fresh shell to meet the needs of the public fishery, aquaculture, and restoration.

The shortage of shells has led to the use of alternative substrates to restore oyster reefs. To encourage recycling of oyster shells, the Oyster Recovery Partnership (ORP) has developed the Shell Recycling Alliance, a group of 250 restaurant owners, caterers, seafood distributors, and citizens, as a mechanism for collecting shells for habitat and seed. Since the inception of the program in 2010, 249,325.3 bu of shell have been recycled, with 20,358.5 bu collected from October 1, 2020 to October 1, 2021 that go to Horn Point Hatchery for sanctuary spat-on-shell production. Since July 2013, residents and businesses can receive a tax credit per bushel of recycled oyster shell up to $750 per year.

The increase in sanctuary areas and aquaculture activities require additional law enforcement. The Natural Resources Police (NRP) are using the Maritime Law Enforcement Information Network (MLEIN). The network is a system of cameras and radar units that can monitor vessel location and movements. Although this system was primarily intended to provide homeland security and assistance to

distressed boaters, it allows the NRP to gather and store evidence of illegal activity, especially in sanctuary areas. The MLEIN has resulted in more arrests and convictions of poachers than in previous years. In addition, an improved penalty system has resulted in license suspensions and revocations.

Figure 1. Spatfall intensity (spat per bushel of cultch) on Maryland "Key Bars" for spat monitoring, including annual median values (1985-2021).

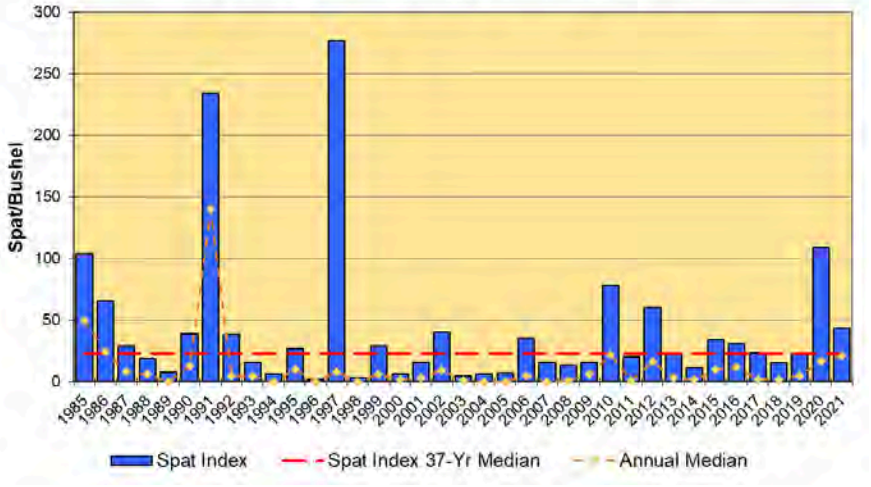


Figure 2. Maryland oyster biomass index, a measure of relative oyster abundance and weight, 1993 - 2021. Values are relative to 1993 biomass, which was set at a value of 1.

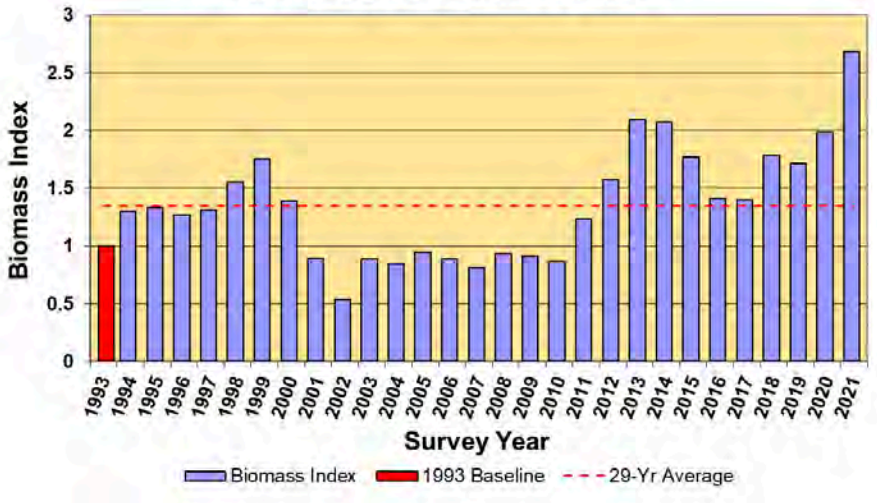
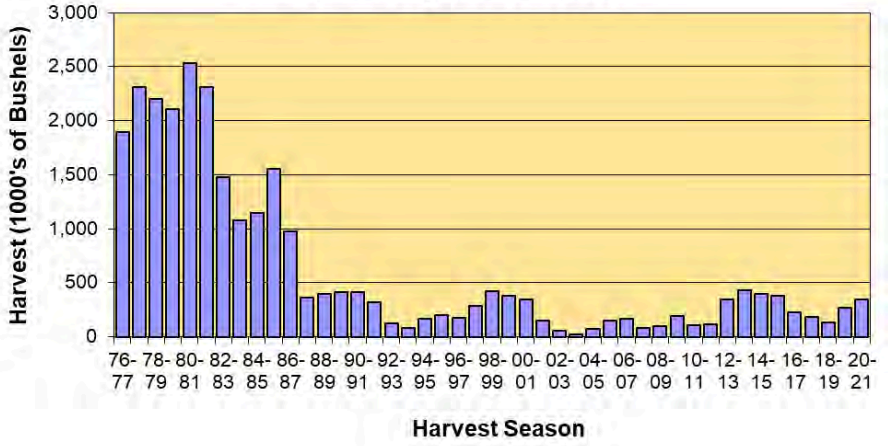


Figure 3. Maryland commercial oyster harvest, 1977– 2021.



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2019 Oyster Management Plan (OMP) Implementation Table			
Strategy	**Action**	**Date**	**Comments**
Adaptive Management Strategy 2.3 The MD DNR has practiced and will continue to practice a policy of adaptive management. Before oyster projects are implemented in Maryland's Chesapeake Bay, the results of previous efforts will be considered to formulate the best approach for each project.	Action 2.3.1 Utilize the best available data and knowledge from oyster projects collectively to maximize the success of each project.	Continue	Work towards this action is ongoing in all aspects of oyster management.
	Action 2.3.2 Utilize the following essential elements of adaptive management as a guideline to improve the success of oyster projects in consultation with stakeholders and partners: 1. Project Design: The MD DNR will provide as much information as possible about the methods and performance metrics for each project. 2. Objectives: Project objectives must relate to one or more of Maryland's oyster objectives. 3. Project Review Process: Project plans and site designations should be evaluated through an ongoing review process. 4. Monitoring: Projects must specify an adequate monitoring protocol and include, if necessary, funding to implement the monitoring. Data will be collected in a standardized format and maintained in compatible databases. 5. Evaluation: Results of projects will be shared among the restoration partners and stakeholders through the ongoing project review process and through the development of information management systems. 6. Application: The lessons learned from all of the previous steps will be incorporated into the next iteration of the adaptive management process starting with the project design, thereby improving the project outcomes over time.	Continue	Work towards this action is ongoing in all aspects of oyster management.
	Action 2.3.3 Utilize public notices to modify oyster fishery parameters as an adaptive management measure.	Completed	In 2019, the MD DNR implemented a new regulation that all harvest limits to be set annually through public notices. Also, the MD DNR implemented a new regulation to close and re-open public fishery harvest areas through public notices.
Salinity Influences on Oyster Populations Strategy 2.4 Consider the influence of salinity on oyster populations when developing management	Action 2.4.1 Consider how salinity influences reproduction, growth and mortality (particularly from disease and freshets) when developing oyster project objectives for sanctuaries and harvest areas.	Continue	Work towards this action is ongoing in all aspects of oyster management.
	Action 2.4.2 Continue to closely examine current environmental parameters in each zone since salinity patterns will vary annually and	Continue	Work towards this action is ongoing in all aspects of oyster management.

strategies and actions for the oyster resource.	zonal boundaries will shift and adjust actions as necessary to reach oyster project outcomes.		
Partner Strategy 2.5 The MD DNR will promote the effective coordination of state, federal and local agencies, organizations, and stakeholders to meet oyster outcomes for the ecology, culture and economy of the Chesapeake Bay.	Action 2.5.1 Engage state, federal and local agencies, organizations, and stakeholders in the development and implementation of effective coordination strategies that maximize cooperation and meet oyster resource planning objectives and policies.	Continue	Work towards this action is ongoing in all aspects of oyster management.
Substrate Strategy 3.0 Promote the conservation and protection of natural oyster substrate (oyster shell) and evaluate and utilize alternative substrates as a method to ensure that the rate of habitat accretion exceeds loss.	Action 3.0.1 Develop a decision-making process on how to equitably utilize limited natural shell and alternative substrates for sanctuary restoration, fishery enhancement and aquaculture and make decisions according to the process.	Not Started Yet	This may be initiated if the MD DNR obtains shell from Man-O-War Shoals.
	Action 3.0.2 Explore options for the mitigation of shell loss.	Continue	The MD DNR continues to utilize fresh shell and alternative substrate plantings to account for shell loss.
	Action 3.0.3 Promote the creation of oyster reefs with higher profiles above the bay bottom to enhance oyster productivity.	Continue	Substrate restoration in the large-scale restoration sanctuaries have a reef height of 6 to 12 inches at the time of construction.
	Action 3.0.4 Develop a shell budget that will lead to practical applications, such as but not limited to, managing shell plantings, enhancing reef restoration, identifying areas of harvest closures/openings and determining total allowable catch.	Not Started Yet	The MD DNR has not developed a shell budget. However, the 2017 Annual Fall Oyster Dredge Survey developed a cultch index to monitor the amount of shell. Also, in 2019, the Chesapeake Bay Program Fisheries Goal Implementation Team released a report on the Chesapeake Bay shell budget: Mann, R., M. Southworth, J. Wesson, J. Thomas, M. Tarnowski, and M. Homer. 2019. A Shell Budget for the Chesapeake Bay Oyster Resource. A final report prepared for the Chesapeake Bay Trust.
	Action 3.0.5 Evaluate and develop cost-effective strategies to identify sources and quality of shell and alternative substrate to supplement oyster habitat throughout Maryland's Chesapeake Bay.	Not Started Yet	The MD DNR has not developed a cost-effective strategy yet.
	Action 3.0.6 Develop comprehensive maps of current oyster habitat within Maryland's Chesapeake Bay that include updated oyster bar boundaries and utilize best available data to locate oyster	Not Started Yet	An updated bay bottom survey is needed prior to this action being completed. This survey will begin in 2022.

	habitat and ground-truth the best areas for placing available substrate.		
	Action 3.0.7 Promote and support shell recycling from viable public or private sources.	Continue	Shell recycling is ongoing. Recycled shells are utilized in the hatchery towards the production of the spat-on-shell to be used in large-scale restoration in sanctuaries. Shells are recycled from restaurants and festivals in MD, DC, VA, and PA.
	Action 3.0.8 Evaluate potential strategies including private sector engagement, public-private partnerships (P3s), and economic incentives to retain processed shell in Maryland.	Not Started Yet	The MD DNR has not identified and evaluated these strategies yet.
	Action 3.0.9 Evaluate the feasibility and effectiveness of utilizing different alternative substrates in public fishery areas for the purpose of improving harvest.	Continue	The MD DNR is proposing a study to determine natural spatfall rates on different substrates (e.g. small stone) in MD's public fishery harvest areas. The MD DNR has reached out to VA to gather information about their harvest areas having a small stone substrate base.
Stock Status Strategy 4.0 The status of the oyster stock will be evaluated through periodic stock assessments using monitoring data, best available scientific methodology, environmental considerations and other relevant information and used to guide oyster management.	Action 4.0.1 Continue to conduct oyster monitoring, including fishery independent and fishery dependent surveys, to provide data for the stock assessment.	Continue	Work towards this action is ongoing
	Action 4.0.2 Conduct a Maryland Chesapeake Bay stock assessment at least once every two to five years to provide information on the status of oysters, re-examine stock assessment methods and parameters and make any necessary adjustments to the biological reference points.	2021 Continue	The MD DNR conducted an update of the stock assessment in 2021. The last stock assessment was completed in 2020.
	Action 4.0.3 Continue to refine the oyster stock assessment by improving and incorporating available data.	Not Started Yet	As the stock assessment was just completed in 2018, a benchmark stock assessment has not been required yet.
Biological Reference Point Strategy 4.1 Utilize biological reference points generated through the most recent stock assessment to determine the status of the oyster stock.	Action 4.1.1 Utilize biological reference points to determine the status of the oysters in Maryland's Chesapeake Bay and update the biological reference points based on the stock assessment.	2021 Continue	The MD DNR conducted an update of the stock assessment in 2021.
	Action 4.1.2 Develop risk-averse harvest management strategies based on the biological reference points to achieve the target harvest fraction. 1) Determine the appropriate regional scale for managing oysters. 2) Develop triggers for implementing management measures when targets and thresholds are not met or exceeded such as a certain percentage of small oysters that may become market-size in the future within a specific NOAA code.	Not Started Yet	The MD DNR has not started this yet based on biological reference points.

	3) Engage stakeholders in the process of developing harvest management strategies.		
	Action 4.1.3 Evaluate and develop target levels of abundance including biological limits of abundance.	Continue	The MD DNR has proposed utilizing the OAC to develop target abundance biological reference points.
Sanctuary Strategy 5.0 Continue to maintain a sanctuary program throughout Maryland's Chesapeake Bay with the purpose of protecting broodstock, enhancing natural recruitment and providing ecological services.	Action 5.0.1 Maintain a network of clearly marked oyster sanctuaries throughout Maryland's Chesapeake Bay and its tributaries.	Continue	There are 253,411 surface acres in oyster sanctuaries, of which 31% (78,520 acres) is historic oyster bottom. Historic oyster bottom is defined as the area charted in the Yates Oyster Survey from 1906 to 1912 plus its amendments, and does not necessarily represent the productive oyster bottom in 2016, nor at the time of the Yates survey itself. These areas are marked by buoys and in the Maryland Shellfish Closure Areas book which each commercial licensed watermen receives annually after the purchase of an oyster surcharge.
	Action 5.0.2 Ensure sanctuaries are of sufficient size, include at least 20 to 30% of productive oyster bottom and 50% of the 'best bars' are distributed to promote regional oyster production and ecological services, and are managed based on defined and measurable criteria.	Continue	78,520 acres of historic oyster bottom is located in sanctuaries and 142,006 acres of historic oyster bottom is located in PSFA. This equates to 24% in sanctuaries and 76% in PSFA. Based on the number of 'best bars' located in sanctuaries, 50% of the 'best bars' are within sanctuaries.
	Action 5.0.3 Continue to utilize oyster seed (wild seed and/or hatchery-reared spat-on-shell) to increase the existing oyster population in sanctuaries where appropriate.	2021 Continue	Over 5 billion hatchery reared spat-on-shell have been planted in the five large-scale restoration sanctuaries.
	Action 5.0.4 Continue to monitor sanctuaries to evaluate oyster population status and measure progress toward the commitment to increase oyster biomass and abundance.	Continue	The MD DNR continues to monitor most all sanctuaries using the Annual Fall Oyster Dredge Survey and Patent Tong Population Surveys. The National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers (USACE) have ongoing monitoring surveys in the five large-scale restoration sanctuaries to determine if populations are restored.
	Action 5.0.5 Consider the following steps when establishing a new oyster sanctuary or expanding the size of an existing sanctuary in Maryland's Chesapeake Bay: 1. Evaluate the biological and physical parameters of an area and justify how designating the area as a sanctuary will provide regional ecological services and increase oyster abundance and biomass. 2. Develop a restoration and monitoring plan for the area. 3. Ensure new sanctuary boundaries are clearly marked and easily enforceable. 4. Monitor and evaluate the effectiveness of the sanctuary using appropriate standards and timeframe.	Not Required Yet	There has not been a new sanctuary established.

	5. Ensure that boundaries do not divide existing oyster bars when possible.		
	Action 5.0.6 Consider the following steps when removing a sanctuary or reducing the size/area of a sanctuary: 1. Justify why the sanctuary should be removed or modified based on scientific information gathered over time (e.g. ten years of data indicates that an area has poor habitat, low oyster densities or is not performing to expected outcomes of increased oyster production and beneficial ecological services). 2. Justify how if the area was not an oyster sanctuary it could: a. Contribute to the goal of increasing oyster production; and/or b. Provide economic and/or cultural benefits to another community; and/or c. Be replaced by creating a new oyster sanctuary area. 3. If removal of a sanctuary designation would likely further the goal of increasing oyster production, develop a plan to manage this area to increase the oyster population, including the appropriate metrics for tracking population size in the area and identify the costs and funding sources for implementation of the plan and associated monitoring program. 4. Conduct seed and/or substrate planting activities as mitigation, if necessary, in other sanctuary areas.	Not Required Yet	No sanctuary has been reduced in size or removed.
	Action 5.0.7 Conduct an updated 'best bar' analysis to determine if there has been a spatial shift in oyster productivity of the 'best bars'.	2021 Continue	The MD DNR has conducted a new 'best bar' analysis. This analysis was included as an appendix of the Five Year Oyster Management Review: 2016-2020.
Oyster Gardening Strategy 5.1 Continue to support citizen-based oyster gardening efforts through outreach, technical advice and funding, if available.	Action 5.1.1 Assist gardening programs to increase the number of stakeholders involved, through outreach, education and attendance of local meetings to provide information and advice.	Continue	The MD DNR works with the ORP to conduct Marylanders Grow Oyster Program.
	Action 5.1.2 Identify and authorize appropriate areas within sanctuaries for planting oysters raised by oyster gardeners and maintain these planted areas as sanctuaries. Continue to confirm planting areas with oyster gardening groups in advance of the planting season.	Not Required Yet	No new planting areas have been requested.
	Action 5.1.3 Continue to require Marylanders Grow Oysters program participants and other oyster gardeners to register annually and report the quantity of oysters planted, planting date(s),	Continue	The MD DNR works with the ORP to gather this information.

	receiving site location (latitude/longitude) and any other data the MD DNR deems appropriate.		
	Action 5.1.4 Develop a comprehensive and accurate record-keeping system for the Marylanders Grow Oysters program.	Continue	The MD DNR works with the ORP to gather this information.
	Action 5.1.5 Ensure that all oyster gardening activities, both state-run programs as well as private oyster gardening activities, follow the requirements of the National Shellfish Sanitation Program Model Ordinance to protect public health and comply with the U.S. Army Corps of Engineers federal permit requirements.	Continue	The MD DNR is working on new regulations to ensure compliance with NSSP requirements.
	Action 5.1.6 Identify new sources of funding for gardening efforts such as Marylanders Grow Oysters.	Not Started Yet	The MD DNR has not started this yet. In 2019, this program was conducted using $20,000 from MD state capital funds and the remaining with private funding obtained by the ORP.
Fishery Management Strategy 6.0 Adopt biological reference points (target and threshold fishing rate) at an appropriate spatial scale that can be used to manage harvest at a sustainable level and develop management measures in conjunction with stakeholders.	Action 6.0.1 Evaluate the potential use of management tools including those referenced in Appendix A, either separately or in conjunction with each other and implement them to manage the oyster resource consistent with the fishery management strategy.	Continue	The MD DNR continuously utilizes multiple management tools in Appendix A to manage the oyster resource.
	Action 6.0.2 Improve the accuracy and specificity of reported harvest data on buy tickets submitted by seafood dealers in compliance with reporting requirements.	2021 Continue	An electronic harvest reporting system to report seafood dealer buyticket data began in 2021. This was a pilot project with a cap of 50 users in the first year. It will continue in future years but be opened to any dealer wishing to participate.
	Action 6.0.3 Improve accuracy and specificity of reported harvest data by commercial licensed harvesters in compliance with reporting requirements.	2021 Continue	An electronic harvest reporting system to report monthly harvester data began in 2021. This was a pilot project with a cap of 50 users in the first year. It will continue in future years but be opened to any harvester wishing to participate.
	Action 6.0.4 Monitor the oyster fishery and population to determine fishing mortality rates in relation to biological reference points.	2021 Continue	The Annual Fall Dredge Oyster Survey monitoring the oyster population in public fishery harvest areas. The MD DNR conducted an updated stock assessment in June 2021 and determined current fishing mortality rates in relation to the biological reference points.
	Action 6.0.5 Conduct fishery-dependent sampling of oyster size distribution to better quantify the number of oysters per bushel and the number of undersized oysters per bushel.	Not Started Yet	The MD DNR has not conducted a new survey to determine the number of oysters per bushel covering a greater spatial and temporal scale than the 2018 survey.
	Action 6.0.6 Continue to monitor latent effort and work with the commercial industry and other stakeholders to identify potential strategies to control or decrease effort if necessary.	Continue	The MD DNR continued to identify strategies to control or decrease effort if requested by the industry and other stakeholder.
Fishery Management Areas Strategy 6.1	Action 6.1.1	Not Started Yet	A new bay bottom survey is expected to begin in 2022.

Identify and maintain the designation of productive oyster habitat.	Conduct a new bay bottom survey in Maryland's Chesapeake Bay and delineate the boundaries of oyster bars. Using the results of the survey and other quantitative data: 1. Redefine boundaries of Maryland's oyster bars and publish new oyster bar charts as necessary. 2. Manage the oyster resource based on the new charted boundaries of Maryland's oyster bars and not the older charted Yates Bars, Non-Yates Bars, NOBs or PSFA.		
	Action 6.1.2 Allow for the modification of charted boundaries of Maryland's oyster bars based on the results of a biological survey or other quantitative data.	Not Started Yet	The MD DNR has not started a bay bottom survey yet thus bar boundaries have yet to change.
Harvest Reserve Strategy 6.2 Develop guidelines for managing harvest and monitoring oysters in Harvest Reserve Areas.	Action 6.2.1 1. Mark each Harvest Reserve Area with buoys and list the coordinates of each area in the State of Maryland Shellfish Closure Areas book. 2. Apply the statutory criteria for allowing or prohibiting harvest in Harvest Reserve Areas based on the desired biological characteristics of the population. 3. Monitor the oyster population in Harvest Reserve Areas (e.g., population size, age structure and disease prevalence and intensity). 4. Use stock enhancement management tools and/or habitat modification tools as appropriate in Harvest Reserve Areas. 5. Open and close Harvest Reserve Areas based on the monitoring results using all required public notice procedures.	Continue	There are two harvest reserve areas (Bramleigh Creek and Evans) being utilized by the fishery to date.
Rotational Harvest Strategy 6.3 Work toward a more sustainable harvest by managing fishing effort and monitoring oysters on specific bars using Rotational Harvest Areas.	Action 6.3.1 Create Rotational Harvest Areas 1. Develop a plan for each Rotational Harvest Area that includes the following information: a. Open and closed periods for each portion of the area. b. Stock enhancement and substrate planting actions. c. Monitoring program establishing the frequency of monitoring, data to be collected and who will conduct the monitoring. d. Budget and funding sources for planting activities and monitoring. e. Criteria for opening each portion of the area (e.g., a specific percentage of the oysters are market size). f. Harvest management parameters for the area (e.g., bushel limits, time/day limits).	Not Started Yet	The MD DNR has not implemented a rotational harvest area program yet.

	g. Adoption of additional methods for managing the rotational area if needed (e.g., entry limits). h. Methods for collecting accurate harvest information. 2. If an area is proposed to be a rotational harvest area and it is already classified as another management area type, it will need to be reclassified as a Rotational Harvest Area. 3. Manage the area in accordance with the plan. 4. Include Rotational Harvest Areas in the State of Maryland Shellfish Closure Areas book. 5. Comply with all public notice procedures for opening and closing an oyster bar established by the MD DNR in regulation.		
	Action 6.3.2 Monitor, assess and modify Rotational Harvest Areas as appropriate to ensure the desired outcomes are being achieved.	Not Started Yet	The MD DNR has not implemented a rotational harvest area program yet.
Seed Area Strategy 6.4 Increase regional oyster populations by recruiting oysters in Seed Areas and transporting the seed to other bars.	Action 6.4.1 Identify oyster habitat in various regions of the Chesapeake Bay that may be able to function as Seed Areas then delineate and manage these areas.	2021 Continue	The MD DNR in conjunction with the St. Mary's County Oyster Committee conducted a shell planting on Gravelly Run in 2019 and 2020 to determine if this area obtains a high enough spatfall to become a seed area. In 2021, seed was moved from this area to the nearby St George's Creek. The MD DNR also is working with the St. Mary's College and St. Mary's River Watershed Association to conduct a spatfall survey in St. Mary's River to determine the location of the highest spatfall which could help guide the location of a seed area.
	Action 6.4.2 Develop and utilize the seed transplanting guidelines to control the movement of disease.	Continue	The MD DNR is continuing to use the 2015 Mollusc Disease Control Policy (Dungan and Marcino, 2015).
	Action 6.4.3 Develop minimum seed counts that maximize the cost efficiency of moving/transporting seed to other areas within the Maryland portion of Chesapeake Bay.	2021 Continue	Wild seed was collected and moved from the St. Marys River to St. George's Creek in 2021. This was a pilot project to better understand a modern day seed movement project. Future analysis from this program and others will continue to inform this action.
Opening and Closing Oyster Bars Strategy 6.5 Increase survival and abundance of oyster populations by managing fishing effort through the opening and closing of oyster bars.	Action 6.5.1 Consider the following steps when deciding to open or close an oyster bar (or portion of a bar). 1. Mark a closed area with buoys. 2. Determine the criteria for opening a bar. Criteria may vary depending on regional differences or management objectives, such as disease, salinity, size and seasonal time periods. 3. Monitor the closed area to determine when the criteria for opening the area is met (e.g., size structure (oyster shell length) of the oyster population).	2021 Continue	Multiple portions or whole bars were closed in 2021 per the request of the county oyster committees or directly by the department. Monitoring occurred on some of these to determine if they should be opened to harvest. Public notices were issues for these openings and closings.

	4. Set harvest management parameters (e.g., specific bushel limits, time/day limits) for an opened oyster bar while taking into account enforcement concerns. 5. Comply with all public notice procedures for opening and closing an oyster bar established by the MD DNR in regulation.		
Replenishment Strategy 6.6 Use replenishment plantings to maintain and increase sustainable bar productivity for the public fishery.	Action 6.6.1 Continue to utilize the current hatcheries to produce larvae for setting new spat-on-shell.	2021 Continue	In 2021, the MD DNR utilized private growers to produce and plant 240 million spat-on-shell on public fishery harvest areas. This is ongoing in 2022.
	Action 6.6.2 Encourage the development of private hatcheries to produce larvae for sale.	2021 Continue	A new private hatchery Ferry Cove in Talbot County, MD opened in 2021.
	Action 6.6.3 Encourage the development of private spat setting facilities to produce spat-on-shell.	Continue	The MD DNR continues to utilize private growers from spat-on-shell plantings.
	Action 6.6.4 Evaluate and consider future funding opportunities or the use of public-private partnerships (P3s) to support replenishment plantings.	Continue	The MD DNR continues to support the Maryland Seafood Co-Op.
Public Health Strategy 6.7 To protect public health, oyster harvesters must follow the sanitation guidelines established by the National Shellfish Sanitation Program and the Interstate Shellfish Sanitation Conference and abide by the areas approved for shellfish harvest by the Maryland MD DNR of the Environment.	Action 6.7.1 Require any person engaged in wild oyster harvest, aquaculture activities or oyster gardening and any person dealing in oysters, to comply with the requirements of the National Shellfish Sanitation Program Model Ordinance. This includes, but is not limited to, requiring compliance with all training, licensing, permitting, oyster handling, reporting and tagging in the Model Ordinance.	Continue	The MD DNR continues to enforce the model ordinance.
	Action 6.7.2 Ensure that the National Shellfish Sanitation Program Model Ordinance is properly administered and enforced by the MD DNR.	Continue	The MD DNR continues to enforce the model ordinance.
	Action 6.7.3 Mark areas designated as Restricted or Conditionally Approved (when in the closed status) by the Maryland Department of the Environment.	Continue	The MD DNR continues to mark areas as required.
	Action 6.7.4 Implement and enforce the Maryland Vibrio Control Plan.	Continue	The MD DNR continues to enforce the vibrio control plan.
Recreational Harvest Strategy 6.8 Improve management of the recreational oyster	Action 6.8.1 Collect data on recreational oyster harvest including, but not limited to, catch and effort.	Not Started Yet	The MD DNR has not started collecting recreational harvest information with the exception of anecdotal information.
	Action 6.8.2	Not Started Yet	The MD DNR has not started collecting recreational harvest information with the exception of anecdotal information.

fishery through increased knowledge and understanding of harvest.	Determine appropriate management measures for recreational oyster harvest based on collected data.		
	Action 6.8.3 Conduct outreach efforts to inform the public of closed harvest areas, and general oyster harvest and public health rules.	2021 Continue	The annual Shellfish Closure Book was published in 2021 and posted online.
Aquaculture Strategy 7.0 Continue to provide incentives for private investment in shellfish aquaculture production and continue to locate areas for leasing within state waters.	Action 7.0.1 Partner with other local, state and federal agencies, academics, non-governmental organizations, industry representatives and other stakeholders to further streamline state and federal permitting and to continue to implement and operate financing, education and training programs and support the development of additional industry infrastructure.	Continue	The MD DNR continues to work closely with the USACE, Baltimore District to further streamline the federal permit process for shellfish aquaculture and assist in providing application materials needed by federal partner agencies to complete their respective reviews of proposed projects within established deadlines.
	Action 7.0.2 Identify areas suitable for submerged land and/or water column leases where the leases would not adversely impact existing living resources.	2021 Continue	In the calendar year 2021,new shellfish leases were issued. The MD DNR consulted with many of these applicants and provided assistance in identifying suitable areas that were available for lease.
	Action 7.0.3 Manage the oyster aquaculture industry to assure compliance with state and federal regulatory program requirements.	Continue	The MD DNR managed all shellfish harvest in accordance with the Control of Harvest Element of the NSSP. The Food and Drug Administration (FDA) evaluates the State for compliance with this program. In 2016 and 2017 the FDA found the MD DNR to be in full compliance with the program resulting in a shift to a biennial evaluation cycle. The evaluation in 2019 documented the MD DNR's continued full compliance with the program.
Monitoring Strategy 8.0 Support and enhance monitoring activities to assess the status of the oyster resource, track restoration and replenishment efforts, and evaluate management strategies and actions.	Action 8.0.1 Conduct monitoring programs using scientifically accepted and consistent sampling procedures, timing, data collection and analysis, and provide the results to a central database or databases. Coordinate sampling methodology among federal, state and non-governmental organizations for consistency, taking into account sampling during different times of the year and sampling with different gear types.	Continue	The MD DNR continues to conduct annual monitoring of oyster populations with consistent procedures and spatial and temporal coverage. The data is entered and QAQC'ed into a centralized database.
	Action 8.0.2 Continue the annual Fall Oyster Dredge Survey to monitor population trends and effectiveness of replenishment and restoration plantings, and serve as the basis of the stock assessment.	Continue	The MD DNR continues to conduct the Annual Fall Oyster Dredge Survey.
	Action 8.0.3 Continue the Oyster Patent Tong Population Survey to estimate population abundance and biomass.	Continue	DNR did not conduct patent tong sanctuary surveys in 2021, but did in 2020 and plans on conducting more in 2022.
	Action 8.0.4	Continue	DNR continues to conduct the Annual Fall Oyster Dredge Survey within the five large-scale restoration sanctuaries. NOAA and the

	Continue monitoring efforts of the large-scale restoration projects in sanctuaries to assess the outcome of restoration efforts.		USACE continue to monitor reefs to determine if the areas are restored as defined by criteria listed in the Oyster Metrics report.
	Action 8.0.5 Maintain or increase funding to conduct necessary monitoring activities, if available.	Continue	The funding level is being maintained.
	Action 8.0.6 Consider alternatives or improvements to existing monitoring methods to increase accuracy and precision of fishing mortality estimates.	Continue	In 2021, the MD DNR worked with the ORP to utilize an electronic harvest reporting system.
	Action 8.0.7 Consider and implement recommendations for changes to the Fall Oyster Dredge Survey, harvest reporting, and other surveys identified or used in the stock assessment and peer review reports.	Not Started Yet	The MD DNR has not started this yet, however it is expected to occur in 2022.
	Action 8.0.8 Utilize scientific data collected by other entities when appropriate to assess the status of the oyster resource, track restoration and replenishment efforts, and evaluate management strategies and actions.	2021 Continue	The MD DNR utilizes external groundtruthing bottom surveys to determine suitable areas for restoration in the large-scale restoration sanctuaries. In 2021, the ORP surveyed ~75 acres to determine the suitability of each reef to receive spat-on-shell restoration. The MD DNR utilizes external diving and patent tong data within the large-scale restoration sanctuaries to track reef restoration status. The MD DNR utilizes external data in other aspects of monitoring.
Socioeconomic Strategy 9.0 Promote and support the socioeconomic benefits from the oyster industry, aquaculture and ecological services including restoration.	Action 9.0.1 Continue to promote and support the analysis of socioeconomic data from the oyster industry, aquaculture, restoration efforts, and ecological services.	2021 Continue	The MD DNR continues to examine socioeconomic data. An estimated dockside value for the 2020-2021 public fishery harvest was $10 million.
	Action 9.0.2 Utilize a consensus process to engage stakeholders, advisory groups and scientists on oyster resource policies and management issues that will result in decisions that have broad support among the oyster groups.	Continue	The MD DNR continues to work with the OAC, County Oyster Committees, Tidal Fisheries Advisory Commission, and Sport Fisheries Advisory Commission, as well as other stakeholders.
	Action 9.0.3 Continue working with state agency partners and stakeholders on the development of a nutrient credit trading market to advance Chesapeake Bay restoration goals and provide economic benefits to the oyster industry.	Continue	The MD DNR is continuing to work with the Maryland Department of the Environment to develop a nutrient credit trading market for nitrogen and phosphorus removed by oysters.
Enforcement Strategy 10.0 Continue to strengthen the enforcement of oyster management measures	Action 10.0.1 Evaluate and implement the following enforcement measures: ● Increase enforcement staff to provide for additional marine patrols. ● Utilize fines and administrative sanctions to deter violations.	Continue	The NRP continue to enforce regulations and statutes related to the oyster resource.

established in statute and regulations, and by public notice.	● Continue efforts to penalize repeat offenders in the fishery by license/entitlement suspension and revocation. ● Buoy all closed and restricted areas as possible. ● Educate the general public, members of the judicial system and stakeholders including commercial fishermen on oyster harvest laws and regulations and changes in those laws and regulations. ● Produce and distribute an annual State of Maryland Shellfish Closure Areas book that has maps and coordinates of closed areas and make the information available online. ● Continue utilizing a citizen hotline for reporting violations. ● Implement harvest management measures that improve enforceability (e.g., prohibit culling while off an oyster bar). ● Develop appropriate enforcement practices to protect oysters in closed areas and consider the use of the MLEIN network, helicopters and other tools for detecting poaching over a broad geographic area.		
	Action 10.0.2 Strengthen enforcement efforts related to public health violations involving oyster harvest and sale.	Continue	The NRP continues to enforce regulations and statutes related to public health and oyster harvest/sales.
Ecological Strategy 11.0 Develop policies that protect the ecological functioning of oyster reefs and promote the importance of oysters for their ecological services.	Action 11.0.1 Support the ecological role of oysters for their structural and habitat importance, their ability to enhance water quality and their role in nutrient and energy cycling.	Continue	The MD DNR's sanctuary program continues to support the ecological services provided by oysters.
	Action 11.0.2 Consider conducting an oyster vulnerability assessment to evaluate potential climate change effects and incorporate the results into the management process.	Not Started Yet	The MD DNR has not started conducting an analysis on the potential impact of climate change on oysters.
	Action 11.0.3 Utilize decision-support models to design restoration efforts that maximize ecosystem benefits including but not limited to credits for water filtration and denitrification.	Continue	The MD DNR is continuing to work with the Maryland Department of the Environment to develop a nutrient credit trading market for nitrogen and phosphorus removed by oysters.
	Action 11.0.4 Utilize oysters as a Best Management Practice to reduce nitrogen and phosphorus toward meeting the Total Maximum Daily Load goals.	2021 Continue	The MD DNR continues to support the Chesapeake Bay Program project to accept oysters as a Best Management Practice. Spat-on-Shell planted on aquaculture leases can be utilized. In 2019, spat-on-shell planted in sanctuaries was accepted as a BMP.
	Action 11.0.5 Work with the Maryland Department of the Environment to develop a nutrient crediting system for oysters produced by aquaculture and removed by the public fishery.	Continue	The MD DNR is continuing to work with the Maryland Department of the Environment to develop a nutrient credit trading market for nitrogen and phosphorus removed by oysters.

	Action 11.0.6 Work with the Maryland Department of the Environment to develop a nutrient crediting system for oysters in areas closed to harvest that are part of the denitrification process.	Continue	The MD DNR is continuing to work with the Maryland Department of the Environment to develop a nutrient credit trading market for nitrogen and phosphorus removed by oysters.

Acronyms

DC – District of Columbia
FDA – Food and Drug Administration
MD – Maryland
MD DNR – Maryland Department of Natural Resources
MGO – Marylanders Grow Oysters Program
MLEIN – Maritime Law Enforcement Information Network
NOAA – National Oceanic and Atmospheric Administration
NRP – Natural Resources Police
NSSP –National Shellfish Sanitation Program
OAC – Oyster Advisory Commission
OMP – Maryland Chesapeake Bay Oyster Management Plan
OMR – Oyster Management Reserve Program of the Potomac River Fisheries Commission
ORP – Oyster Recovery Partnership
PA – Pennsylvania
PSFA – Public Shellfish Fishery Areas
QAQC – Quality Assessment and Quality Control
USACE – U.S. Army Corps of Engineers
VA – Virginia

2021 Maryland FMP Report (December 2022)
Section 15. Red Drum (*Sciaenops ocellatus*)

The most recent red drum stock assessment was completed in 2017. Abundance status for either the northern or southern stock was unable to be determined, and there was a high degree of uncertainty present in the models. While it was determined that overfishing was not occurring, any regulations that would increase mortality on the adult stock have been discouraged. Due to these concerns, the Atlantic State Marine Fisheries Commission (ASMFC) board approved a new two-step assessment process for red drum at the February 2020 meeting. The first step was a simulation assessment, which used simulated data to explore the strengths and weaknesses of potential assessment techniques. The first step has been completed, and the Simulation Assessment and subsequent Peer Review Report were approved by the Sciaenids Management Board at the May 2022 meeting. The second step, the red drum benchmark stock assessment, is now in the beginning phases, and is on track to be completed in 2024.

Fishery Management Plans (FMPs)

The ASMFC adopted a Fishery Management Plan (FMP) in 1984 to protect the red drum spawning stock. Since then, several changes have been made. Amendment 1 (1991) to the FMP was adopted to attain optimum yield from the fishery over time. Amendment 2 (2002) requires states to comply with recreational limits to meet the target fishing mortality. Addendum I (2013) identifies key habitats and habitats of concern for red drum. The coastal FMP management unit consists of states from Florida to New Jersey.

The Chesapeake Bay Red Drum Fishery Management Plan (CBRD FMP) was adopted in 1993 to address overfishing and to follow the ASMFC guidelines. Stock assessment needs, habitat, and water quality concerns were addressed. Coastal management measures since 2000 have resulted in reduced fishing mortality.

Stock Status

In the 1980s and 1990s, the coastal red drum stock was overfished, and management measures were implemented to reduce fishing mortality (F) and rebuild the stock. Two management stocks are recognized: the northern stock (NC to NJ) and the southern stock (FL to SC). The distinction between stocks is based on differences in life history traits, such as growth rates, age, and migratory habits. An Atlantic coastwide benchmark stock assessment was conducted by ASMFC, and was reviewed by the Southeast Data, Assessment, and Review (SEDAR) team, with data through 2013. The assessment used a new model, Stock Synthesis 3 (SS3), to assess coastal red drum stocks. Due to some concerns the Board had with the new model, they requested the Red Drum Stock Assessment Subcommittee to develop Statistical Catch-at-Age (SCA) models similar to what was used in the 2009 stock assessment. The revised models were peer reviewed and accepted for management use by ASMFC in February 2017. The 2017 ASMFC stock assessment found that the stocks were not experiencing overfishing, but whether the stocks were overfished could not be determined.[1] The threshold and target are based on a three-year average escapement rate that provides a 30% and 40% static spawning potential ratio (sSPR), respectively. An sSPR below 30% indicates that overfishing is occurring. The most recent three-year average sSPR for the northern and southern stocks were 43.8% and 53.5%, respectively. The lack of data for fish age 4+ inhibited the derivation of adult stock size, and did not allow for the determination of an overfished status.

Due to the shortcomings of the 2017 assessment, a new two-step assessment process for red drum was initiated in 2020. The first step began in 2020 with a simulation assessment, which used simulated data to explore the strengths and weaknesses of potential assessment techniques. The results of the simulation assessment were presented to a review panel, who recommended that a Stock Synthesis model (a statistical catch-at-age model developed in the SS program) should used to assess both the northern and southern stocks of red drum, with the Traffic Light Approach being used as an accessory tool between assessments.[2] These recommendations were approved by the Sciaenids Management Board at the May 2022 meeting to be used in the red drum benchmark stock assessment, which is on track to be completed in 2024.

There is no formal red drum stock assessment for the Chesapeake Bay. In most years, red drum are not frequent visitors to Maryland's portion of the Chesapeake Bay, due to lower salinities. Red drum are frequently reported from Virginia waters, where salinities are higher. Schools of red drum below the minimum size limit and over the maximum size limit are seen in years of low freshwater flow such as 2012, a year of unusually high catches.

Current Management Measures

Red drum are managed through size limits and creel limits in compliance with all current ASMFC FMP requirements. All harvests occur in state waters. Maryland allows recreational fishermen to take 1 fish per day between 18 inches and 27 inches. Charter boat logs show that anglers in Maryland release most of the red drum they catch.[3] Commercial fishermen in Maryland are allowed 5 fish per day, with a slot limit of 18 inches to 25 inches. Virginia allows a slot limit of 18 inches to 26 inches, and a possession limit of 3 fish per day for recreational fishermen, and a slot limit of 18 inches to 25 inches, and a creel limit of 5 fish per day for commercial fishermen. The Potomac River Fisheries Commission (PRFC) has a slot limit of 18 inches to 25 inches, and a possession limit of 5 fish per day for recreational and commercial fishermen. There are no closed seasons for the recreational or commercial fisheries.

The Fisheries

Commercial harvest from the Chesapeake Bay states has averaged 7,142 lbs since 2000 (Figure 1), and makes up a small proportion (4%) of the total commercial catch from the Atlantic coast. The majority of the commercial catch from the Atlantic coast is from North Carolina. Three southern states have given red drum game fish status, and prohibit commercial harvest (FL, GA, & SC).

Red drum are one of the most highly sought recreational species along the southern Atlantic coast. In Maryland's portion of the Chesapeake Bay, red drum are only seasonally available for a relatively short period, in late summer to early fall. Consequently, the estimates for recreational harvest from Maryland are low most years. The recreational harvest estimates from Virginia are generally much higher (Figure 2).

Issues/Concerns

Red drum have been identified by ASMFC as a priority species in need of research. Coastal states are developing a cooperative plan to collect more age/length data to improve stock assessment modeling results particularly for the adult portion of the population. Maryland will continue to monitor commercial pound nets and fish houses, and measure red drum when they are encountered. The 2017 coastal stock assessment recommendation for red drum was to avoid management measures that might increase fishing mortality on older fish.

The Maryland Sport Fisheries Advisory Commission asked the Maryland Department of Natural Resources (MD DNR) in 2013 to consider allowing recreational fishermen to take one large red drum. Since red drum are managed by the ASMFC, allowing any harvest of fish over 27 inches would require an amendment to the FMP. Such an amendment is unlikely in the absence of supporting data and increased monitoring.

Submerged aquatic vegetation (SAV) beds are important red drum habitat. Efforts by the EPA, and state programs to achieve SAV restoration and water clarity goals will continue. In 2013, ASMFC approved Addendum I to Amendment 2 to the Red Drum Fishery Management Plan.[4] Addendum I revised the habitat section to include the most current science on red drum habitat requirements for all life history stages. Habitat identification and description, habitats of concern, and potential threats to recovery and sustainability were also defined.

Figure 1. Commercial red drum landings for Maryland, queried from Maryland's commercial landings database, and Virginia, queried from NMFS : 1981-2021.[5]

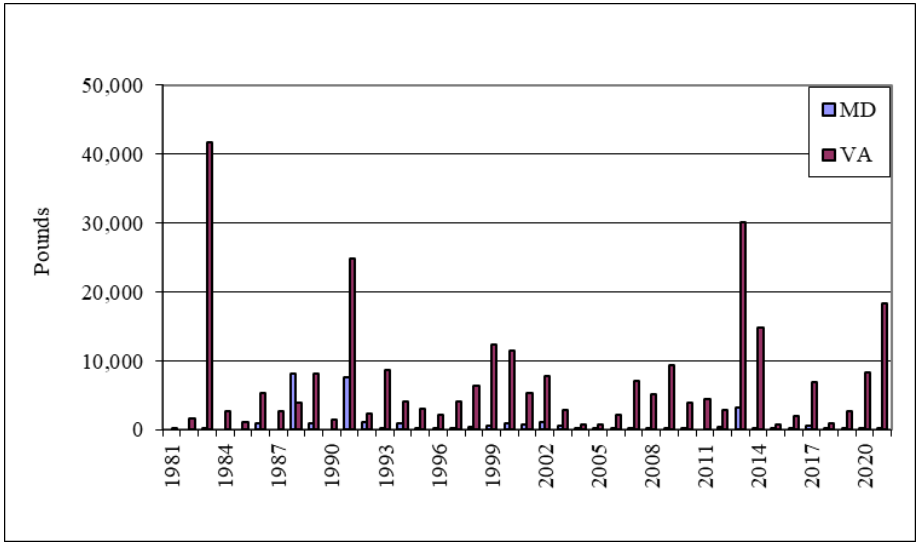
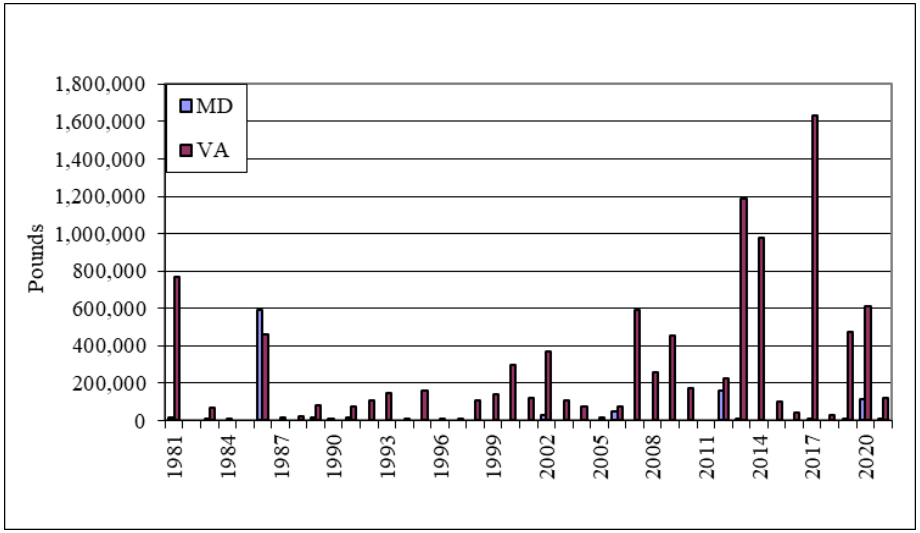


Figure 2. Total recreational red drum MRIP harvest estimate for Maryland and Virginia, all modes combined, 1981-2021.[6]



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[1] Atlantic States Marine Fisheries Commission. 2017. Atlantic States Marine Fisheries Commission Red Drum Benchmark Stock Assessment & Peer Review Report. Arlington, VA. 522p.

[2] Atlantic States Marine Fisheries Commission. 2022. Atlantic States Marine Fisheries Commission Red Drum Simulation Assessment and Peer Review Report. Arlington, VA. 101p.

[3] 2017. Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Red Drum (Sciaenops ocellatus) 2016 Fishing Year. 20p.

[4] Addendum I to Amendment 2 to the red drum fishery management plan: Habitat Needs & Concerns. Approved August 2013. 24p

[5] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. September 1, 2022. http://www.st.nmfs.noaa.gov/commercial-fisheries/index

[6] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. September 1, 2022. http://www.st.nmfs.noaa.gov/st1/recreational/index.html

1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table			
Section	**Action**	**Date**	**Comments**
1. Overfishing	1.1.1 Virginia will continue to enforce a 5 fish creel limit, and an 18" minimum size limit, with one fish over 27"in the recreational fishery.	1992 2003 2015 2017	In compliance with coastal recommendations. VA has adopted a slot limit, and now allows harvest of 18-26" red drum. A new possession limit of 3 fish has been adopted for both recreational and commercial harvest. Effective January 1, 2015, VA will allow recreational fishermen 3 fish per day between 18-26", and commercial fishermen 5 fish per day between 18-25". The 2017 peer reviewed ASMFC stock assessment determined that overfishing was not occurring, and that the overfished status could not be determined due to data limitations. The sSPR for the northern stock was above both the overfishing threshold and target.
	1.1.2 Maryland and the PRFC will implement a 5 fish creel limit, and an 18" minimum size limit, with one fish over 27" in the recreational fishery	1994 2003 Continue	In compliance with coastal recommendations. MD has a recreational size limit for red drum of 18-27", and a commercial size limit of 18-25". The possession limit is 1 fish/day for the recreational fishery, and 5 fish/day for the commercial fishery. PRFC has a size limit of 18-25", and a possession limit of 5 fish for both recreational and commercial harvest.
	1.2a Jurisdictions will investigate the potential for using bycatch reduction devices in nonselective fisheries	1992 Continue	The bycatch of immature red drum has not been a problem in Chesapeake Bay fisheries because small fish are infrequently encountered. Bycatch reduction devices that are currently in place should increase the escapement of juvenile red drum.
	1.2b Virginia and Maryland will work with the South Atlantic Fishery Management Council (SAFMC) and ASMFC to develop and require more efficient gear to reduce bycatch and/or discards.	1992 Continue	MD and VA appointed representatives to the ASMFC/SAFMC Red Drum Advisory Panel. MD and VA have representatives on the ASMFC technical committee. MD does not currently have a representative on the Red Drum Advisory Panel.
2. Stock Assessment and Research Needs	2.1 Jurisdictions will support fecundity research and tagging studies to determine movements of juvenile red drum, and develop juvenile indices. Maryland and Virginia will continue the Baywide trawl survey of estuarine finfish species and crabs.	1993 Continue	The VA red drum tagging program is ongoing. The tagging program includes a fishery independent study, and a volunteer recreational study. Tag recapture data indicates a southward, late fall migration of juvenile red drum out of the Bay, and along the Virginia coast. Future tag returns should provide information about the movements of these fish upon reaching sexual maturity. The Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) continues, but the collection of red drum is not sufficient to guide any stock assessment. The Maryland Shoal Water (blue crab) Trawl Survey continues (data for fish and crabs). ASMFC has recommended that all states implement a tagging program for red drum. ASMFC

			has continued to facilitate standardized ageing protocols and consistency among laboratories.
	2.2 VMRC Stock Assessment Program will continue to collect biological data from commercial catches of red drum	1993 Continue	There is little fishery dependent information on larger, reproductive red drum and limited fishery-independent information (ASMFC). Large adults are primarily found offshore where fishing for red drum is prohibited.
	2.3a Jurisdictions will continue collecting commercial fisheries statistics.	Continue	Maryland's red drum harvest remains insignificant; many years of zero harvest have been reported, and the greatest catch on record was 8,100 lbs in 1988. Virginia's commercial harvest is more substantial, but the state is still a minor contributor to coastwide landings.
	2.3b Virginia will implement a limited and/or delayed entry program, and a mandatory reporting system for commercial licenses.	1993 Continue	Implemented in January 1993.
	2.3c Virginia and Maryland will continue to supplement the Marine Recreational Statistics Program	Continue	MD charter boat logs reported 70 red drum caught in 2021, 16 of which were harvested. The Marine Recreational Information Program (MRIP) has replaced MRFSS with refined estimates of recreational harvest and total catch. In early 2018, MRIP calibrated previous year estimates to the new mail survey-based effort estimation. The new estimation procedure and calibration lead to higher estimates of recreational fishing effort, and therefore higher annual catches for most species including red drum. Percent standard error values are above 50 for all MD estimates, indicating very imprecise estimates.
	2.3d Maryland will continue a sampling program using pound nets and trawls.	Continue	Maryland conducts fishery dependent sampling from pound nets in the Chesapeake Bay, but red drum are not frequently observed. Twenty-three red drum were encountered in 2021, the fourth highest number encountered in the 29 years of the survey, with a mean total length of 886 mm.
3. Habitat Issues	3.1 Jurisdictions will continue to set specific objectives for water quality goals, and review management programs established under the Chesapeake 2000 agreement	2000 2014 Continue	New water quality and SAV goals were adopted by the Chesapeake Bay Program signatory states in 2014, as part of the Chesapeake Watershed Agreement. For more information, a summary of the agreement can be viewed at the following link http://www.chesapeakebay.net/documents/ChesapeakeBayWatershedAgreemenetFINAL.pdf SAV beds are important red drum habitat. In 2012, SAV acreage in the Chesapeake Bay, estimated by aerial surveys, declined to near record lows observed in the mid-1980s. Substantial recovery has occurred since 2012, and SAV coverage was estimated at 108,960 acres in 2018, which was the highest acreage observed by the survey (1984-2019). Unfortunately, due to higher than average freshwater input (and associated sediment and nutrient pollution), SAV coverage declined to 66,387 acres in 2019. In 2021, SAV coverage was 67,470 acres. The overall SAV restoration goal in a

			restored Chesapeake Bay is 185,000 acres. https://www.chesapeakeprogress.com/abundant-life/sav

Acronyms

ASMFC – Atlantic States Marine Fisheries Commission
Board – South Atlantic State/Federal Fisheries Management Board
CBRD FMP – Chesapeake Bay Red Drum Fisheries Management Plan
CIE – Center for Environmental Experts
EPA – US Environmental Protection Agency
F – fishing mortality
FMP – Fishery Management Plan
MRFSS – Marine Recreational Fisheries Statistics Survey
MRIP – Marine Recreational Information Program
NMFS – National Marine Fisheries Service
PFRC – Potomac River Fisheries Commission
SAV – Submerged Aquatic Vegetation
SAFMC – South Atlantic Fisheries Management Council
SCA – Statistical Catch at Age
SEDAR – Southeast Data Assessment and Review
SS3 – Stock Synthesis 3
sSPR – static Spawning Potential Ratio
VIMS – Virginia Institute of Marine Science
VMRC – Virginia Marine Resource Commission

2021 Maryland FMP Report (December 2022)
Section 16. Scup (*Stenotomus chrysops*)

Scup in 2021 were managed under Amendment 13, which divided the quota between the recreational (22%) and commercial (78%) fisheries. In December 2021 ASMFC and MAFMC passed an amendment to change the recreational/commercial catch allocation to reflect new Marine Recreational Fishing catch estimates that went into the most recent stock assessment. The new catch allocation is 35% recreational and 65% commercial. These changes, while passed in December of 2021, are due to be in place beginning in January of 2023. Progress was also made on the harvest control rule addendum to the management plan that considers changes to the way recreational harvest measures are calculated. This change in management is due to be passed in 2022 and will take effect in 2023.

Fishery Management Plans (FMPs)

A Chesapeake Bay/Atlantic Coast fishery management plan (FMP) has not been developed for scup. The Maryland Department of Natural Resources' (MD DNR) authority to manage scup comes from its designation as a species in need of conservation, that was established in 1994.[1]

The ASMFC and the Mid-Atlantic Fishery Management Council (MAFMC) jointly manage scup along the Atlantic coast. The ASMFC manages the scup fisheries in state waters (out to 3 miles), while MAFMC manages the scup fisheries in federal waters (3-200 miles offshore). Scup were incorporated into the ASMFC and MAFMC summer flounder FMPs in 1996. Since then, a series of amendments and addenda have been implemented to modify management measures.

ASMFC Addendum IV (2001) established procedures that simplified, clarified, and expedited the setting and implementation of fishery specifications. Addendum V (2002) established a state-specific quota for the summer fishery. Addenda III (2001), VII (2002), IX (2003), XI (2004), and XIII (2004) implemented catch and minimum size limits for recreational fisheries. Addendum XVI (2005) established measures to ensure prompt implementation of compliance requirements. Addendum XX (2009) clarified the procedures for state-to-state quota transfers. Addendum XXIX (2017) allows better utilization of the commercial quota by shortening the summer period, and extending the winter period. Addendum XXXI (2018) allows the utilization of new management tools and reduces the inconsistencies between state and federal regulations.

The MAFMC established an initial overfishing definition with Amendment 12 in 1999. In 2007, MAFMC established a rebuilding plan with Amendment 14, established annual catch limits and accountability measures with Amendment 15 (2011), and modified the measures with Amendment 19 (2014). Several frameworks (addenda) have been implemented since 1996. Amendment 17 (2015) was passed by the MAFMC to ensure that all FMPs of the Greater Atlantic Region, developed under the jurisdiction of the New England and Mid-Atlantic Councils, comply with the standardized bycatch reporting methodology (SBRM) requirements of the Magnuson-Stevens Act. The amendment does the following: (1) Explains the methods and processes by which bycatch is currently monitored and assessed for Greater Atlantic Region fisheries; (2) Determines whether these methods and processes need to be modified and/or supplemented; (3) Establishes standards of precision for bycatch estimation for all Greater Atlantic Region fisheries; and (4) Documents the SBRMs established for all fisheries managed through the FMPs of the Greater Atlantic Region.[2] Framework 9 (2016) modified the southern and eastern boundaries of the Southern Scup Gear Restricted Area. Framework 12 (2018) modified the dates of the commercial scup quota periods, and Framework 13 (2018) modified the accountability measures for overages caused by discards from the scup fishery.

In 2019, the National Marine Fisheries Service changed the incidental possession limit for the commercial fishery. The incidental possession limit applies to vessels with commercial moratorium scup permits fishing with nets with diamond mesh smaller than 5 inches in diameter. The incidental possession limit was previously 1,000 lbs during October 1 to April 30 and 200 lbs during May 1 to September 30. The action adds another threshold period from April 15 through June 15 to allow for higher retention in the small-mesh squid fishery that operates during that time and occasionally catches larger amounts of scup than the current landing limits. During that time vessels using small mesh can land up to 2,000 lbs of scup.

Stock Status

An operational assessment using data through 2019 indicated that the scup stock was not overfished and overfishing was not occurring. Spawning stock biomass was estimated at 186,578 metric tons, about two times the spawning stock biomass target of 94,020 metric tons. The 2021 management track assessment update of the indices suggest the 2017-2019 year classes are below average, and spawning stock biomass is projected to decrease toward the target unless more above average year classes recruit to the stock in the short term.[3]

Current Management Measures

The ASMFC and MAFMC determine a total annual quota that is divided between the commercial and recreational fisheries. The commercial quota was set at 20.5 million lbs for the 2021 fishing seasons, and the recreational harvest limit was set at 7.66

million lbs. The majority of coastwide scup harvest is allocated to the commercial fishery (78%). The remaining 22% of harvest is allocated to the recreational fishery. Maryland's commercial fishery is open all year, with a minimum size limit of 9 inches in state and Federal waters. All commercial harvesters in federal waters must have a federal permit.

The annual coastwide commercial quota is divided among three fishing seasons: January to April (Winter I = 45%), May to October (Summer = 39%), and November to December (Winter II = 16%). Winter fisheries are managed with trip limits. Winter I is 50,000 lbs per trip until 80% of quota is caught, at which point it drops to 1,000 lbs per trip.[4] Winter II landings were set at 12,000 lbs per trip. If the winter I quota is not reached, the winter II possession limit increases by 1,500 lbs for every 500,000 lbs of quota not caught during winter I. During the summer period, various state-specific possession limits are in effect. Until 2019, trawl vessels could not possess 1,000 lbs or more of scup during October to April, or 200 lbs or more during May to September, unless they use a minimum mesh size of 5 inch diamond mesh applied throughout the codend for at least 75 continuous meshes forward of the terminus of the net. In 2019, another threshold period was added from April 15 to June 15, with a 2,000 lbs possession limit to allow for higher retention in the small-mesh squid fishery.

The summer fishery in state waters is managed by state by state quotas; Maryland's allocation is 0.012%. Federal waters have a coastwide summer quota. Pots and traps for scup are required to have two degradable hinges and escape vents that are either circular with a 3.1 inch minimum diameter or square with a minimum length of 2.25 inches on the side. Fishing gear mesh size and escape panel regulations are in place for the commercial fishery.

Recreational harvest regulations differ between state and federal waters. In Maryland and states south of Delaware in 2021, the minimum size limit was 8 inches, with a possession limit of 50 fish per person, per day. In federal waters, scup limits were 50 fish per day, with a 9 inches size limit.

The Fisheries

In Maryland, the commercial scup harvest occurs in winter as part of the mixed black sea bass/scup/summer flounder fishery. Scup are primarily harvested by trawl, although juveniles are often caught in black sea bass pots. Scup harvest can be highly variable among years (Figure 1). Maryland's 2021 preliminary commercial scup harvest was 78,465 lbs harvested by otter trawl and pot (Source: Maryland Commercial Logbooks).

Recreational landings data are not available for much of the 1980s and 1990s (Figure 2). Maryland's 2021 recreational scup harvest was estimated at 256 fish. The proportional standard error (PSE) is 59.9, indicating that the estimate is not certain. (National Marine Fisheries Service, Fisheries Statistics and Economics Division, Personal communication, April 20, 2022).

Issues/Concerns

The MAFMC monitoring committee will continue scrutinizing bycatch and the effect these changes may have on incidental bycatch mortality. In 2019, MRIP was recalculated and the stock size estimate was increased as a result of higher recreational catch estimates. The new MRIP now indicates higher recreational catch rate and the recreational/commercial allocation formula has not been changed to account for these higher estimates. The allocation percentages are due to be changed in 2022.

Figure 1. The commercial harvest of scup in Maryland since 1950. (Harvest data is not available for the years 1996, 2001-2003; Maryland catch records).

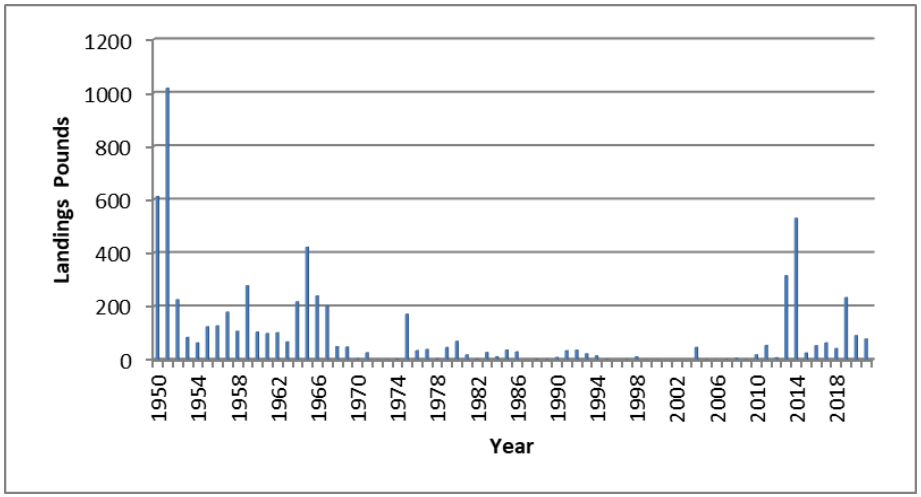
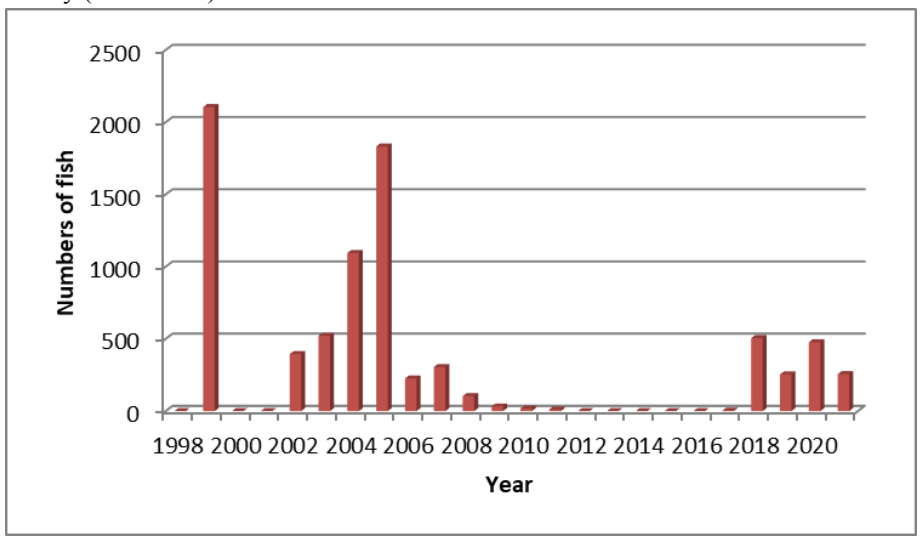


Figure 2. Recreational harvest of Scup landing in Maryland, NMFS Recreational Survey (1950-2021).



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[1] Maryland Office of the Secretary of State. COMAR 08.02.12.03. Retrieved August 11, 2020: https://dsd.maryland.gov/regulations/Pages/08.02.12.03.aspx

[2] Mid-Atlantic Fisheries Management Council. 2015. Standardized Bycatch Reporting Methodology An Omnibus Amendment to the Fishery Management Plans of the Mid-Atlantic and New England Regional Fishery Management Councils.

[3] Northeast Fisheries Science Center. 2021. Mark Terceiro. Scup Management track assessment for 2021.[4] Atlantic States Marine Fisheries Commission. 2002. Addendum V to the scup fishery management plan: Summer period commercial scup allocation. Atlantic States Marine Fisheries Commission. Washington, DC.

[5] Doctor, S. 2022. Maryland's 2021 annual compliance report for scup. Maryland Department of Natural Resources, Stevensville, MD.

[6] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. April 20, 2022. http://www.st.nmfs.noaa.gov/recreational-fisheries/index

2021 Maryland FMP Report (December 2022)
Section 17. Striped Bass (*Morone saxatilis)*

The 2021 fishing season was managed under Addendum VI to Amendment 6 of the Atlantic Striped Bass Interstate Fishery Management Plan. The 2021 recreational harvest was lower than 2020, and the commercial harvest for 2021 was higher than 2020. The Maryland juvenile index was below average for a third consecutive year in 2021, however, it was above the definition of recruitment failure. In May 2022, the ASMFC Striped Bass Management Board approved Amendment 7 to address fishery management issues, including recreational release mortality, conservation equivalency, management triggers, and rebuilding the stock by 2029. A stock assessment update will be conducted in 2022.

Fishery Management Plans (FMPs)

In 1989, the Chesapeake Bay Program developed the Chesapeake Bay Striped Bass Fishery Management Plan (CBSB FMP) to coordinate management among Bay jurisdictions, and to comply with ASMFC FMP requirements. The CBSB FMP was amended in 1998. Amendment 1 formally adopted ASMFC's Amendment 5 management framework for the Chesapeake Bay. Amendment 5 (1995) to the ASMFC FMP required an annual juvenile abundance survey in Maryland and Virginia to monitor recruitment. Maryland's Juvenile Abundance Index (JAI) began in 1954, and Virginia's survey began in 1955. The CBSB plan and amendment have been regularly updated, and periodically reviewed. The most recent review was conducted in 2013/2014. The Maryland Plan Review Team (PRT) concluded that the use of coastal management indices (Fishing mortality (F), Spawning Stock Biomass (SSB), and Juvenile Abundance Index (JAI)) are sufficient for decision-making in the Chesapeake Bay. The PRT recommended the development of a new amendment to incorporate the recent coastal management framework, and recommended utilizing ecosystem-based management specific to the Chesapeake Bay when feasible.

The ASMFC developed the Interstate Fisheries Management Plan for Striped Bass in 1981 (ASMFC FMP). Several amendments and addenda to the ASMFC FMP have been adopted to adjust management measures (1985-2001). Amendment 6 (2003) to the ASMFC FMP replaced all previous ASMFC management documents for striped bass. It includes provisions for target and threshold control rules to effectively manage mortality, spawning potential, and age diversity. Addendum I (2007) implemented additional data collection requirements to improve discard estimates. Addendum II (2010) revised the recruitment failure threshold from an annually updated value (1957 – present) to a set value (1957 – 2009) of 1.60. Addendum III (2012) standardized the use of commercial harvest tags coastwide to reduce illegal harvest. Addendum IV (2014) reduced the Atlantic coast F rate starting in 2015 to a level at or below the target. In Maryland, harvest reductions include a 25% reduction in the Atlantic and Chesapeake Bay trophy fisheries from 2013 harvest levels and a 20.5% reduction in the summer/fall and winter fisheries from 2012 harvest levels (http://www.asmfc.org/species/atlantic-striped-bass).[3] Addendum VI (2019) was implemented to reduce total striped bass removals by 18% relative to 2017 levels to achieve the fishing mortality target.[2] Amendment 7 to the Atlantic Striped Bass Interstate Fishery Management Plan was approved in May 2022.[11]

A NOAA Chesapeake Bay Fisheries Ecosystem Advisory Panel developed a Fisheries Ecosystem Plan (FEP) for Chesapeake Bay in 2006. Maryland Sea Grant was contracted to facilitate FEP development for five keystone Chesapeake Bay species including striped bass. State, federal, and academic representatives completed a series of issue briefs in 2009 that identified current and future ecosystem stressors: habitat (warming, flow, eutrophication/hypoxia, pollution/contamination, and watershed development), food web (forage and predation), stock assessment (recruitment variability, exploitation, disease, and connectivity), and socioeconomic (livelihoods, recreation, and consumption). The briefs were forwarded to a Quantitative Ecosystem Team (QET) tasked with development of measurable targets and reference points. No targets or reference points have been developed to date.

The EBFM striped bass summary brief can be found at https://www.mdsg.umd.edu/sites/default/files/2019-12/EBFM-Striped-Bass-Summary-1.pdf

The full striped bass brief can be found at https://www.mdsg.umd.edu/sites/default/files/2019-12/EBFM-Striped-Bass-Briefs-1.pdf

Stock Status

In April 2019, the benchmark stock assessment was approved by the ASMFC Management Board for use in striped bass management. The model indicated that in 2017, the stock was overfished and overfishing was occurring. As a result, Addendum VI was approved in October 2019. A stock assessment update is scheduled for 2022.

Striped bass are managed under target and threshold biological reference points (BRPs) for F and SSB. The BRPs were updated in the ASMFC's 2019 Benchmark Stock Assessment Report for Atlantic Striped Bass. The F target for striped bass in coastal waters is 0.20 and the F threshold is 0.24. Separate BRPs for Chesapeake Bay were not developed in the 2019 Stock Assessment report but the Technical Committee will continue to work on developing Chesapeake Bay reference points.[1,10] In the meantime, the Chesapeake Bay stock will be assessed under the coastwide reference points.

The 2017 estimate of F from the 2019 benchmark stock assessment (F=0.307) exceeded the F threshold. The female SSB target was 114,295 metric tons (MT) (252 million pounds lbs) while the SSB threshold was 91,436 MT (202 million lbs). The 2017 coastwide SSB from the 2019 benchmark stock assessment was 68,476 MT (151 million lbs) which is below the threshold.[1,10] The 2021 season was managed under Addendum VI. A conservation equivalency proposal was approved for the 2021 summer/fall recreational fishery (see Current Management Measures). The 2022 season will also be managed under reduction measures implemented under Addendum VI.

The Maryland Department of Natural Resources (MD DNR) has conducted the Estuarine Juvenile Finfish Survey since 1954 to measure young of year (YOY) striped bass abundance and to calculate a JAI using a geometric mean. The JAI is a predictor of year class strength and is used to monitor YOY recruitment success. If the Maryland striped bass JAI falls below a value of 1.60 for three consecutive years, it would trigger management action by ASMFC.[4] The 2021 JAI was below average (4.32) at 1.65. The 2020 JAI was below average at 1.12 and the 2019 JAI was below average at 1.95 (Figure 1). The Maryland JAI is one of six indices that are calculated for different regions of the Atlantic coast including Maine, New York, New Jersey, Virginia, and North Carolina.[5]

Current Management Measures

Addendum VI established management measures to achieve mandatory reductions in recreational and commercial removals for the 2021 season.[2] The Chesapeake Bay is managed under a separate commercial quota that is allocated among the Bay jurisdictions. Maryland's 2021 Chesapeake Bay striped bass commercial quota was 1.44 million lbs, the same as 2020 and 1.8% lower than 2019 (1.47 million lbs; Figure 2).[6] The 2021 commercial quota allocated to the common pool fisheries was 39,026 lbs. The remaining quota was allocated to the individual transferable quota (ITQ) fishery with no gear-specific restrictions.[6] The Maryland Atlantic commercial quota was 89,094 lbs and could be harvested with drift gill net or otter trawl. The recreational (including charter) fishery in Chesapeake Bay attained reductions in the trophy and summer/fall harvests through changes in size limits and seasonal closures (Figure 3).[6] Regulations for striped bass in Maryland may be adjusted annually based on ASMFC requirements and stakeholder concerns.

Watermen and MD DNR began implementation of a catch shares management system with the 2014 commercial season. Each waterman had the option to remain in the traditional common pool management framework or switch to an ITQ management framework. The common pool fishery has a single quota shared among all participants. An ITQ guarantees each participating waterman a portion of the commercial quota. Quota allocation is based on a waterman's historical landings record through February 29, 2012. Watermen can transfer quota to other watermen with an ITQ.

Commercial fisheries are managed using quotas and seasonal restrictions by gear type: pound net, haul seine, hook and line, and drift gill net. In 2015, the quota was decreased by 20.5% for Chesapeake Bay and by 25% for Atlantic Ocean commercial fisheries to meet Addendum IV compliance requirements. These reductions continued through the 2019 seasons. In 2020, a conservation equivalency plan for Addendum VI was implemented to reduce the commercial quota by 1.8%. Maryland's Chesapeake Bay commercial fisheries operated with an 18 inches - 36 inches total length slot limit. All fisheries except gill net were open from June 1 to December 31. The pound net fishery was open from Monday to Saturday and the haul seine fishery was open from Monday to Friday. The hook and line ITQ sector was open from Monday to Thursday while open days for the common pool sector varied during the fishing season. The drift gill net fishery was open from January 1 to February 28 and December 1 to December 31. The ITQ sector operated from Monday to Friday while open days for the common pool sector varied during the fishing season. The Atlantic Ocean drift gill net and otter trawl fisheries had a 24 inches total length minimum size limit. Atlantic coast fisheries were open from Monday to Friday on January 1 to May 31 and October 1 to December 31.

Striped bass caught by the commercial fishery must be individually tagged and landed at a certified check station prior to sale.[4] All fish harvested are counted and weighed. Check stations verify each fisherman's daily harvest record on the fisherman's harvest permit. Fishermen submit monthly harvest reports to MD DNR. Check stations call in harvest figures and submit a weekly report. Fishermen and check stations have the option to submit harvest data electronically through FACTS* or SAFIS* reporting systems. Check stations are opportunistically sampled by MD DNR biologists to collect age, length, and weight data for federal compliance reporting.

Recreational harvest is managed with seasonal and spatial restrictions. No recreational harvest of striped bass is allowed in the Chesapeake Bay and Potomac River during the January 1 to February 28 catch and release fishery. Regulations to control recreational catch and release effort during the pre-spawn period (March 1 to March 31) were implemented in 2010. During this time, anglers are prohibited from using stinger hooks, required to use barbless hooks when trolling, required to use circle hooks or J hooks with a gap < ½ inch when using bait, and allowed up to six lines per boat when trolling. Fishing is allowed in the mainstem Chesapeake Bay below Brewerton Channel (Patapsco River), Tangier and Pocomoke sounds, and tributaries except those identified as striped bass spawning rivers. From April 1 to April 30, there are no harvest and no targeting regulations to comply with Addendum VI. The 2021 spring trophy season took place from May 1 to May 15, but harvest was restricted to the Chesapeake Bay mainstem south of Brewerton Channel (Baltimore) down to the Maryland-Virginia line, Pocomoke Sound, and Tangier Sound. The size regulations remained at one fish 35 inches or greater, but the season was shortened to comply with Addendum VI.

Allowable fishing locations were less restrictive from May 16 to 31: Chesapeake Bay mainstem from Hart-Miller Island (Baltimore) to the MD/VA border; the lower five miles of the Chester, Choptank, and Patuxent rivers; Pocomoke Sound, and Tangier Sound. All Chesapeake Bay and tributary waters were open to striped bass fishing from June 1 to December 10. The 2021 creel and size limits from May 16 to December 10 were one fish per person per day 19 inches or greater to comply with Addendum VI restrictions. The use of circle hooks was mandatory for live lining or chumming. A seasonal closure (no harvest, no targeting) occurred from July 16 to July 31 to reduce recreational release mortality. Charter boats can keep two fish per person per day 19 inches or greater (one over 28 inches) by utilizing the FACTS™ online reporting system. The fishery transitions to catch and release on December 11 and continues through December 31. The use of eel as bait is prohibited from December 11 to May 31 to prevent deep hooking which increases mortality.

Spring recreational regulations differed somewhat for upper Chesapeake Bay waters including the Susquehanna Flats. The striped bass fishery was catch and release only from December 10 to March 31. The fishery was closed from April 1 to May 15. The 2021 fishery re-opened with a 1 fish per person per day creel at 19 inches to 26 inches from May 16 to 31.

The 2021 Atlantic coast recreational fishery regulations were one fish per person per day from 28 inches to 35 inches to comply with Addendum VI reductions. The U.S. Secretary of Commerce enacted a moratorium on striped bass harvest in federal waters (Exclusive Economic Zone or EEZ) in 1990. The moratorium remains in effect.
(*Refer to Acronyms p. 20)

A conservation equivalency proposal was approved in 2020 by ASMFC to reduce discard mortality in the summer/fall recreational fishery. The proposal allows anglers to keep one fish per person per day 19 inches or greater, starting May 16. A no harvest, no targeting closure was in effect from July 16 to 31 to reduce recreational release mortality. Circle hook use was required for chumming or live lining.

A map of closed, catch and release, and harvest areas can be found at:
https://dnr.maryland.gov/fisheries/Pages/sb_reg_maps.aspx

An overview of recreational and commercial regulations can be found at:
http://dnr.maryland.gov/Fisheries/Pages/regulations/index.aspx.

The complete list of commercial and recreational harvest restrictions is printed in the Code of Maryland Regulations (COMAR).

The Fisheries

In the Chesapeake Bay, the 2021 Maryland commercial fishery harvested an estimated 1.31 million lbs; 576,889 lbs from the winter gill net fishery and 757,198 lbs from the summer/fall fishery (Figure 2).[6] Atlantic coast landings were estimated at 88,652 lbs.[6]

The NOAA Marine Recreational Information Program (MRIP) estimated recreational harvest in the Chesapeake Bay of Maryland for 2021 was 2.68 million lbs (no harvest in Ocean; Figure 3).[7] Of the 2021 Chesapeake Bay harvest, 6,016 spring migratory fish were harvested by the trophy fishery (Figure 4).[6] The estimated recreational discard mortality for striped bass was 9%, equal to approximately 350,664 fish in the Chesapeake Bay and 2,274 fish in the Atlantic Ocean for 2021.[7]

In 2018, MRIP transitioned from a phone-based survey to a mail-based survey utilizing an angler database to estimate the number of recreational trips. When results from the new method were compared to results from the old method, striped bass recreational estimates of catch were up to 2.3 times higher. Consequently, estimates of recreational catch under the new method were much higher than previous estimates.

Issues/Concerns

The 2019 benchmark stock assessment found that striped bass are overfished and overfishing was occurring in 2017. Fishing mortality exceeded the threshold level in 2017. The SSB has fallen below the threshold level. Addendum VI was approved in October 2019 to reduce total removals by 18% starting in 2020.[2] Amendment 7 was approved in May 2022. A stock assessment update will be completed in 2022.

Tagging data indicate that natural mortality (M) has been increasing, particularly in the Chesapeake Bay, and is above the assumed value. Increased M in the Chesapeake Bay may be linked to the increased prevalence of mycobacteriosis or other factors affecting health.[8] Nutritional status of striped bass has been discussed as a possible health index. Nutrition-based reference points were proposed by Jacobs et al. (2013).[9] Further studies of mycobacteriosis infections in striped bass and its relation to M are needed.

The ASMFC Striped Bass Technical Committee will continue to evaluate stock-specific reference points in producer areas, including the Chesapeake Bay, Delaware Bay and Hudson River. The ASMFC considered developing Addendum V to relax coastwide commercial and recreational regulations and bring the current F closer to the target level (based on the 2016 stock assessment update). The Chesapeake Bay jurisdictions had raised concerns about the economic hardships imposed since Addendum IV. Prior to Addendum IV, the Chesapeake Bay jurisdictions and other producer areas along the coast were managed under a lower target F than the coastal stock.

The development of Amendment 7 was initiated in August 2020. The primary goals of the Amendment are to address current fishery management issues with striped bass. The issues that will be included in the Amendment are recreational release mortality, conservation equivalency, management triggers, and rebuilding the stock by 2029. Amendment 7 was approved by the ASMFC Striped Bass Management Board in May 2022.

The MD DNR Fish Ecosystem and Habitat Program is working to develop striped bass forage indicators using the data from striped bass health monitoring, relative abundance, natural mortality, fall diet studies, and forage relative abundance. Striped bass from the upper Bay feed on a variety of prey including menhaden, bay anchovy, spot, and blue crab. The model and indicators will be reviewed by the ASMFC Biological Ecological Reference Point Group and then the next steps will be determined.

As one of the natural prey items for striped bass, spot are important to the commercial hook and line fishery and the recreational fishery as live bait. Restrictions on spot harvest and/or size limits could significantly impact the striped bass fisheries. A recreational limit of 50 fish per person per day was established for spot in 2021.

Figure 1. Striped bass juvenile abundance index geometric mean values: 1957 – 2021.[5,6] The red line represents the recruitment failure definition (1.60) and the black line defines the target period average (1959-1972) of stable recruitment. The moratorium was in place from 1985 to 1989.

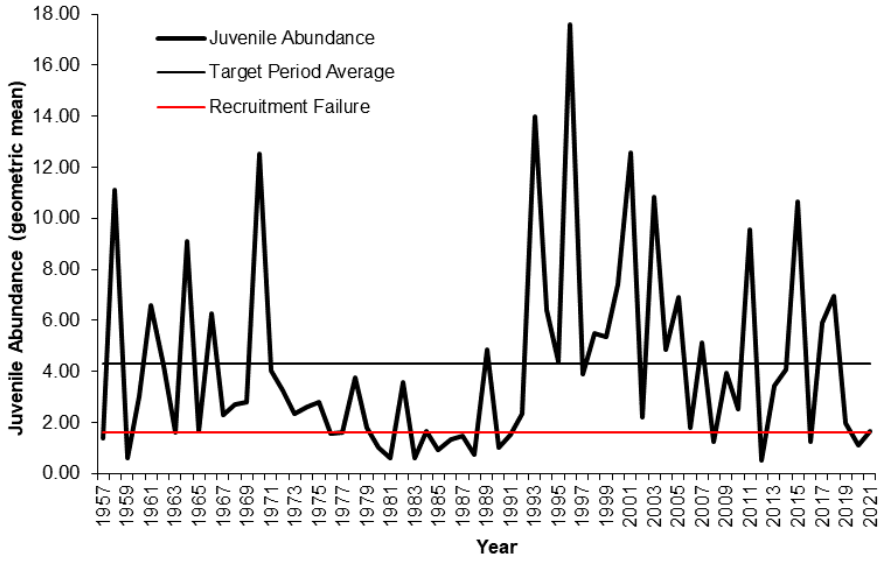


Figure 2. Total commercial striped bass landings (Atlantic and Chesapeake Bay) [6] and Chesapeake Bay landings [6] in Maryland from 1982 to 2021. Total and Chesapeake Bay quota are shown for 2003-2021. The striped bass harvest moratorium was in effect from 1985 to 1989. (http://www.asmfc.org/species/atlantic-striped-bass).

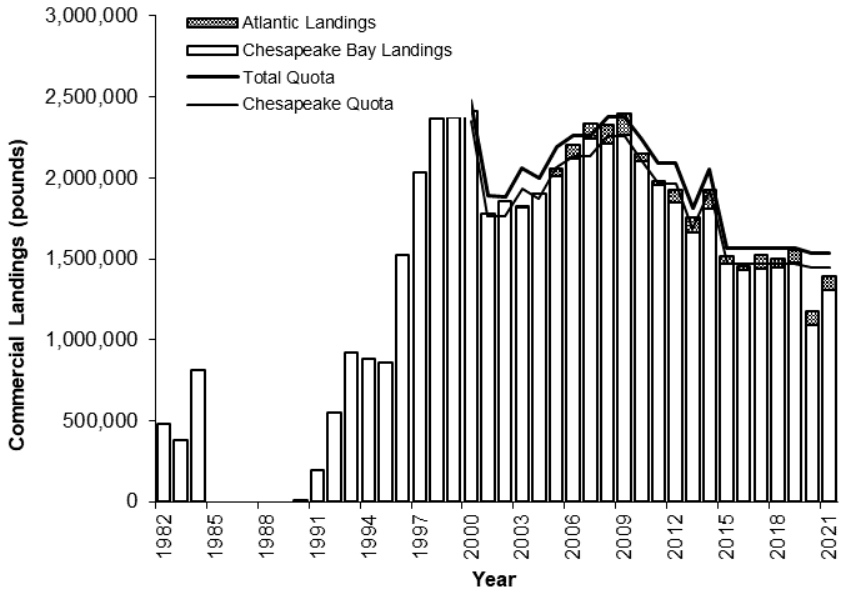


Figure 3. Maryland recreational (including charters) striped bass landings from 1981-2021.[6,7] The striped bass harvest moratorium was in effect from 1985 to 1989.

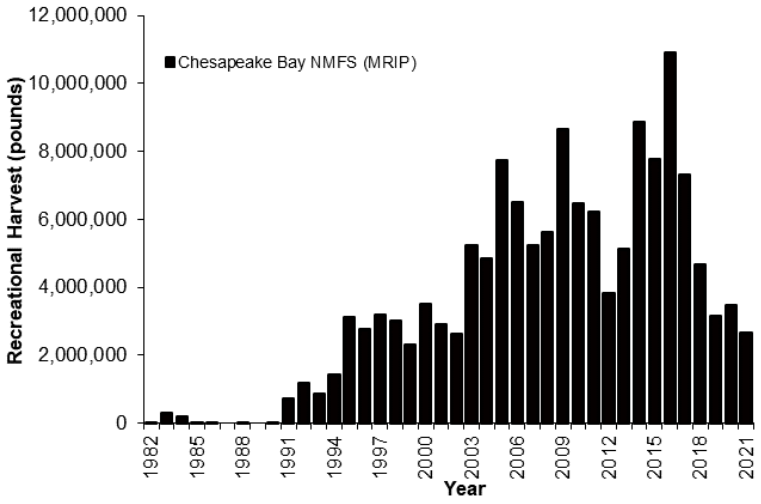
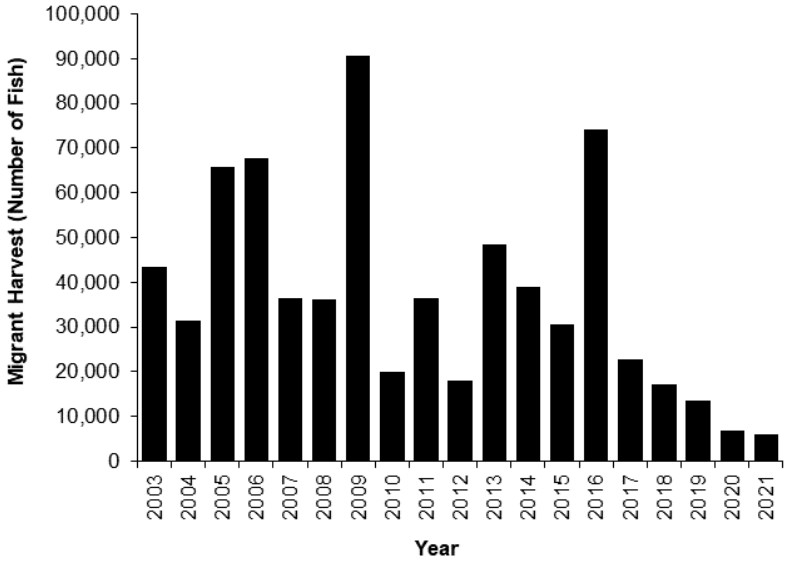


Figure 4. Maryland striped bass migrant harvest from 2003 to 2021.[6] Trophy migrant harvest data submitted as an appendix to the ASMFC annual compliance reporting.



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1989 Chesapeake Bay Striped Bass Management Plan Implementation Table			
Strategy	**Action**	**Date**	**Comments**
1 - Overharvesting, Reduced Spawning Stock and Poor Recruitment: Controlling fishing mortality will be the primary method of maintaining adequate striped bass stocks. Optimum yield per fish will be more closely approached by establishing minimum sizes greater than historic limits. Long term fishery maintenance must be based on a management objective commensurate with reproductive success. The number of eggs per striped bass is directly related to fish size and age. Females will be protected so that more can reach their spawning potential. As reproductive potential is protected and spawning stock increases, more young striped bass should enter the fishery. Two types of fisheries have been defined by the ASMFC: 1) A conservative transitional fishery, which would go into effect after the Maryland striped bass juvenile index has reached a 3-year-average of 8.0; and (2) A more robust recovered fishery, to be considered when a certain percentage of the female spawning stock is composed of striped bass females equal to or greater than age VIII. The percentage will be determined by the ASMFC.		Completed 1995 1995 Continue 2003 2010 Continue 2014 2015 2016 2019 2020 Continue 2022 Continue	Target was 1990 for a transition fishery. The stock was deemed restored in 1995. Juvenile abundance data is used by ASMFC to estimate coastal SSB and SCA of coastal stock. Amendment 6 changed the JAI recruitment failure definition from 90% to 75% of the index for three consecutive years. Addendum II to Amendment 6 established a fixed recruitment failure value of 1.60. Strong recruitment of 1993, 1996, 2001, 2003, 2011, and 2015 year-classes Addendum IV approved to implement management measures to reduce F and to increase SSB. New regulations implemented as required by Addendum IV. Trophy season regulations adjusted, but still implemented as required by Addendum IV. Addendum VI approved to implement management measures to reduce F and to increase SSB. New regulations implemented as required by Addendum VI. Amendment 7 was approved to address fishery management issues, including recreational release mortality, conservation equivalency, management triggers, and rebuilding the stock.
1.1 Fishing mortality will be controlled by several means to protect striped bass stocks. Harvest restrictions will be set to provide a fishing mortality rate of 0.25 (equivalent to about 18% of the legal sized fish being harvested) during a	1.1.1 The District of Columbia, Maryland, Virginia, and the Potomac River Fisheries Commission will utilize a combination of harvest restrictions to meet target fishing mortality rates. Controls may include	2000 Continue 2003 Continue	All CB jurisdictions have implemented regulations to prevent exceeding F_{target}. CBP jurisdictions have the option to implement stricter regulations than required under ASMFC Amendment 6.

transition fishery and a rate of 0.5 (equivalent to about 32% of the legal sized fish being harvested) during a recovered fishery, in accordance with ASMFC guidelines (these percentages may change slightly as additional calculations are made by the ASMFC). Adult stock levels, stock composition, and the Maryland striped bass young-of-the-year index (or other juvenile indices as approved by ASMFC) will be used in determining needed restrictions.	seasonal quotas, daily bag limits, minimum size limits, seasons, time restrictions, gear restrictions, license requirements, and other actions. Maryland's annual quota will be presented as total sport and commercial landings.	2009 Continue 2013 2019 Continue 2022	The overfishing definition is F_{msy}=0.34. If coastwide estimated mortality rates exceed the target rate for 2 consecutive years, the ASMFC will develop management measures. Bay jurisdictions are in compliance with ASMFC guidelines. CB F remains below the target of 0.27. See Strategy 1.2 comments for size limits and Strategy 2.4.1 comments for seasons and time restrictions. BRPs were changed in the update to the 2013 ASMFC Coastal Stock Assessment. New BRPs are a target F=0.18 and threshold F=0.22. BRPs were updated in the 2019 stock assessment. New BRPs are a target F=0.20 and threshold F=0.24. Stock assessment update in 2022.
	1.1.2 Maryland, the Potomac River Fisheries Commission and Virginia will cap commercial harvest during the transitional fishery with a quota not to exceed 20% of the average annual commercial harvest as reported for the period 1972-1979. No commercial fishing is permitted in the District of Columbia.	1990 1995	Implemented. The stock was deemed restored.
1.2 Size limits and fishing mortality rates will be set to allow sufficient recruitment to the spawning stock.	1.2.1 The District of Columbia, Maryland, Virginia and the Potomac River Fisheries Commission will establish a minimum size limit of 18 inches total length in the Chesapeake Bay and tributaries during the transition fishery. Maryland may establish a larger minimum legal size during a May trophy fishery beginning in 1991.	Continue 2015 2016	ASMFC requires that the recreational minimum size limit for striped bass in Chesapeake Bay is 18" except for the spring trophy season. The minimum size limit for striped bass during the spring trophy season in MD is 28". Addendum IV requires the recreational minimum size limit for striped bass in the Chesapeake Bay to be 20 inches except in the trophy season. The trophy season has a minimum size limit of 28 inches and a no take slot limit from 36 to 40 inches. Addendum IV requires the recreational minimum size limit for striped bass to be 20 inches. The trophy season regulations are changed from a slot limit to a 35-inch minimum size limit.

		2017	Regulations implemented as required by Addendum IV
		2018	A conservation equivalency proposal under Addendum IV was implemented to reduce dead discard mortality in the summer/fall fishery. The minimum size limit for striped bass changed to 19 inches starting on May 16.
		2020	Addendum VI implemented. Creel limit reduced to one fish per person.
		Continue	
	1.2.2 Maryland, Virginia and the Potomac River Fisheries Commission will prohibit the keeping and sale of sublegal (fish smaller than the minimum size) striped bass by-catch.	Continue	ASMFC prohibits the sale of sub-legal striped bass (<28"). All striped bass are individually weighed, measured, and tagged at certified check-in stations.
		2012	Harvest tag criteria were standardized, coastwide, with Addendum III.
	1.2.3 As a conservation measure, the District of Columbia, Maryland, Virginia and the Potomac River Fisheries Commission will establish a consistent maximum legal size for striped bass in the Chesapeake Bay and its tributaries.	Continue	DC, MD, PRFC, and VA recreational fisheries are managed with a combination of the 20" – 28" slot limit and a 28" minimum size limit: 2 fish 20" - 28", or 1 fish 20" - 28" and 1 fish ≥28". Spring trophy season size limits for MD and PRFC are 1 fish ≥35" and VA allows 1 fish ≥36". There is not a spring trophy season in DC.
		Continue	Commercial fishery size limits: MD is 18" – 36" for all gear and seasons; PRFC is 18" – 36" from February 15 – March 25 and ≥ 18" from June 1 – December 15, and for gill net ≥ 18" from November 12 – February 14; VA minimum size is 18" all season with a 28" maximum from March 26 – June 15. Commercial fishing is prohibited in DC.
1.3 Fishing mortality rates will be set to ensure a viable female spawning stock of age VIII and older females, and stocks will continue to be enhanced with hatchery production.	1.3.1 During a transition fishery, mortality will be controlled to protect age VIII or older females until they comprise at least a certain percentage (as determined by the ASMFC) of the female spawning population.	2011	Female fish ages 8+ have increased in abundance. Minimum percent of age 8+ females has not been specified by ASMFC.
	1.3.2 A fishery on a recovered stock will be controlled so that females age VIII or older continue to comprise at least a certain percentage (as determined by the ASMFC) of the female spawning stock.	Discontinued	ASMFC uses a VPA to estimate SSB.
		Adjusted during stock assessment	A statistical catch at age (SCA) model is used to estimate SSB. Since 2008, $SSB_{threshold}$ = 66.2 million lbs and SSB_{target} = 82.7 million lbs. Minimum percent of age 8+ females has not been specified by ASMFC.

	1.3.3 Maryland and Virginia will continue hatchery production to enhance striped bass spawning stocks in areas that are still depleted. The District of Columbia will work with the Maryland and Virginia hatchery programs to enhance striped bass spawning stocks.	1993 VA 1995 MD	MD and VA discontinued stocking striped bass.
	1.3.4 Hybrid striped bass stocking and the introduction of non-native stocks will be restricted in the Chesapeake Bay and its tributaries in accordance with ASMFC guidelines. The Maryland Department of Natural Resources, the Pennsylvania Fish and Boat Commission and the U.S. Fish & Wildlife Service will discuss stocking issues regarding the Susquehanna River.	Magothy - 1982 Patuxent - 1984 Pennsylvania – 1990	MD, PA, and USFWS discontinued stocking hybrid striped bass.
2 - Regulatory and Enforcement Issues: In order to control fishing effort and fishing mortality rates, harvest and sale regulations will be developed and implemented. Guidelines will be set for monitoring the resource and harvest restrictions. The individual jurisdictions will comply with ASMFC goals and criteria for the striped bass fishery and, where possible, have compatible fishing regulations. Areas of harvest pressure and times when harvesting pressure will be heaviest will be defined in order to facilitate adequate enforcement. 2.1 The striped bass harvest will be equitably allocated among user groups on a yearly basis.	2.1.1 The Maryland quota will be allocated as follows – 42.5% commercial; 42.5% recreational; 15% charter. Virginia and the Potomac River Fisheries Commission will use various restrictions in fishing seasons and bag limits to equitably allocate and restrict harvest among the commercial, recreational and charter boat fisheries.	Continue 2013 2014	Quota allocation is periodically reviewed. Recreational and charter allocations have since been combined to be 57.5%. The CBSB FMP was reviewed including quota allocation in 2013/2014 by a plan review team. The team recommended the development of a new amendment to adopt the current ASMFC coastal management framework.
	2.1.2 Maryland will terminate the fishing season for each of its three component fisheries when their individual quota is reached, regardless of time during the season. Virginia will terminate its commercial fishing component when its harvest quota is reached, regardless of time during the season. The Potomac River Fisheries Commission will terminate its fishing seasons when the allowable harvest under ASMFC's Striped Bass Plan is reached, regardless of the time during that season.	Continue	MD DNR, VRMC, and PRFC have authority to close their fisheries when quotas are projected to be reached.
2.2 Maryland, Potomac River Fisheries Commission and Virginia will establish commercial gear restrictions to limit fishing effort	2.2.1 Maryland, the Potomac River Fisheries Commission and Virginia will establish a minimum gill net mesh size	Continue	CB jurisdictions are in compliance.

and sublegal by-catch, and to facilitate enforcement.	designed to reduce sublegal by-catch mortality to negligible levels.		
	2.2.2 Maryland and Virginia will require that gill nets be marked, tended, and recovered (except for Virginia's stake nets) daily. The Potomac River Fisheries Commission will continue a fixed location for each gill net licensed in the Potomac.	Continue	CB jurisdictions are in compliance.
	2.2.4 Maryland and Virginia will establish annual quotas for their commercial fisheries.	Continue	State quotas are determined by ASMFC. CBSB FMP includes provisions for how jurisdictions allocate among sectors. MD adopted an allocation policy in 2012.
2.3 Selling and buying procedures and timely reporting requirements will be established to monitor and regulate harvest.	2.3.1 A) Maryland will establish check-in stations for the commercial sale of striped bass.	Continue	CB jurisdictions are in compliance.
	2.3.1 B) Virginia dealers and commercial watermen that harvest striped bass will be required to have a special permit to sell striped bass.	Continue	CB jurisdictions are in compliance.
	2.3.1 C) The sale of striped bass caught by recreational or charter boat fishermen will be prohibited.	Continue	CB jurisdictions are in compliance.
	2.3.2 Maryland and Virginia will establish a weekly reporting system for licensed commercial fishermen and a daily reporting system for buyers during the commercial season. Maryland and Virginia will provide the Potomac River Fisheries Commission with information obtained through their mandatory buyer reporting provisions. The Potomac River Fisheries Commission will reduce the time period required for the finfish reporting system from monthly to weekly.	2006 2009 2010 2011 2011	Electronic reporting was established for check stations and fishermen. Commercial Harvest Reports must be submitted to MD DNR Fisheries Service within 10 days after the end of the month being reported. After 10 days the report is late. Watermen having late reports will be identified on the MD DNR commercial webpage and in the Maryland Watermen's Gazette. Official violations are recorded for a license if a harvest report is not received within 50 days after the due date. Two or more reporting violations may result in license suspension. MD Senate Bill 655 and House Bill 1225 increased the penalty for commercial fishing with a suspended license, a revoked license, or without a license. The fine is up to $25,000 and imprisonment for up to one year. MD House Bill 1252 established a misdemeanor charge and up to two years imprisonment for the unlawful capture of >$20,000 worth of striped bass (based on sale proceeds).

		2014 Continue	Maryland has an optional e-reporting system which helps to improve the accuracy of harvest reports**.** Beginning in 2016, the e-reporting system was expanded to all finfish.
2.4.1 Fishing seasons will be established for the recreational, charter boat and commercial fisheries. The length of the season may be adjusted as needed, including when quotas are reached (see Action 2.1.2), by opening and closing areas to fishing, or with other actions as appropriate. Seasons will be consistent among jurisdictions to the extent possible. Continue 2.4.1	2.4.1 A) The District of Columbia will establish a recreational fishing season within the period June through December.	Completed	The season opens in May and concludes at the end of December.
	2.4.1 B) Maryland will establish fishing seasons within the following periods:	Continue	Fishing season dates are annually reviewed by ASMFC.
	○ The commercial gill net season will be within the period November through March 15.	Dates modified & subject to change	Chesapeake Bay pound net, haul seine and hook and line fisheries were June 1 – December 31. Pound net sector was Monday – Saturday and haul seine was Monday – Friday. Hook and line: ITQ sector was Monday – Thursday, common pool sector's open days varied during the season. Drift gill net was open from Jan. –Feb. 28 and December 1 – 31. ITQ sector was Monday – Friday, common pool sector's open days varied during the season. Atlantic coast: Monday – Friday from January 1 – May 31 and November 1 – December 31.
	○ The commercial pound net/haul seine/fyke net/hook and line seasons will be within the period June through November.		
	○ The recreational and charter boat seasons will be within the period June through November.		
	○ There may be a May trophy fishery for recreational and charter boat fishing, effective May 1991, limited to a single trophy fish per boat per day.	Dates modified & subject to change	Upper Chesapeake Bay (Susquehanna Flats) catch and release: March 1 – March 31, no harvest/targeting April 1 - May 15, and the catch and keep: May 16 – 31. Spring trophy: May 1 – May 15. Summer – fall recreational/charter boat: May 16 – 31 and June 1 – December 10 (closed July 16-31).
	2.4.1 C) Virginia will establish fishing seasons within the following periods:	Dates modified & subject to change	Commercial season is January 16 – December 31 (≥ 18") and March 26 – June 15 (≤ 28").
	○ The commercial netting season will be within the period September through February.		
	○ The recreational and charter boat seasons will be within the period June through December.	Dates modified & subject to change	Recreational Chesapeake Bay spring trophy fishery: ClosedSpring/summer fishery: May 16 - June 15. Fall fishery: October 4 - December 31.
	2.4.1 D) The Potomac River Fisheries Commission will establish fishing seasons within the following periods:	Dates modified & subject to change	Pound net, Haul Seine, and miscellaneous gear: February 15 – March 25 (18" – 36") and June 1 – December 15 (≥ 18"). Hook and line: February 15 – March 25 (18" – 36") and June 1 – December 31 (≥ 18"). Gill net: November 10 – February 14 (≥18") and February 15 – March 25 (18" – 36").
	○ The commercial gill net season will be within the period November through March.		
	○ The commercial pound net/haul seine/hook and line seasons will be		

	within the period June through December. o The recreational and charter season will be within the period June through December.		Recreational seasons differ by size, possession, and bait limits. Spring season: April 16 – May 15. Fall season: May 16 – December 31.
	2.4.1 E) Maryland, the Potomac River Fisheries Commission and Virginia will annually review the need for a Bay spawning season fishery in relation to the issue of parity with the coastal states.	Continue	Addressed by ASMFC.
2.4.2 Establish time periods when fishing is allowed to aid law enforcement and monitoring.	2.4.2 Maryland will prohibit commercial fishing on weekends and at night during the transitional fishery.	Completed 2014	Weekend and evening/night fishing have been prohibited. Saturday fishing was allowed in the pound net sector.
2.4.3 Maryland, the Potomac River Fisheries Commission and Virginia will maintain appropriate striped bass fishing areas.	2.4.3 Maryland will continue to restrict fishing for striped bass in spawning areas and rivers, and spawning reaches as defined in COMAR 08.02.05.02. Virginia will continue to restrict fishing within the spawning reaches defined in VMRC Regulation 450-01-0034. The Potomac River Fisheries Commission will continue its prohibition on gill netting or striped bass fishing during April and May throughout the entire Potomac River during the transitional fishery.	Completed Continue	Area closures are regulated. Jurisdictions follow ASMFC harvest restrictions.
2.4.4 The District of Columbia, Maryland, the Potomac River Fisheries Commission and Virginia will establish recreational and charter boat creel limits consistent with ASMFC guidelines and dependent on length of season.	2.4.4.1 The District of Columbia, Maryland, the Potomac River Fisheries Commission and Virginia will establish creel limits for the recreational and charter boat fisheries of up to five (5) fish per person per day within the established season.	Continue	Jurisdictions are in compliance with ASMFC harvest restrictions. See Strategy 1.2 for creel limits.
	2.4.4.2 Maryland may allow one trophy fish per boat during a May trophy season.	Continue	Jurisdictions are in compliance with ASMFC harvest restrictions. See Strategy 1.2 for creel limits.
2.5 Maryland, Virginia and the Potomac River Fisheries Commission will establish monitoring programs to provide timely knowledge of harvest and effort data.	2.5.1 Maryland, the Potomac River Fisheries Commission and Virginia will monitor harvest for the striped bass fishery by one or a combination of the following: o Utilize daily trip tickets for commercial and charter fishermen.	1995 - 2003 Continue	Amendment 5 of the ASMFC FMP requires MD and VA to conduct annual juvenile abundance (JAI) surveys. CB jurisdictions are required to compile and submit commercial and recreational fisheries data.

	○ Conduct port sampling of commercial vessels. ○ Conduct onboard sampling of commercial catches. ○ Utilize check-in station sampling to characterize exploited stocks. ○ Require dealer logs ○ Maintain Natural Resource Police activity reports. ○ Utilize aerial overflights to estimate recreational effort. ○ Conduct port and onboard sampling of recreational vessels. ○ Conduct telephone surveys to estimate recreational participation. ○ Utilize mail surveys to estimate recreational catch and effort. ○ Utilize an enhanced National Marine Fisheries Service survey and/or Chesapeake Bay Stock Assessment Committee recreational monitoring data.	Continue 2007 2008 2011 Continue	Monitoring programs include the Maryland Estuarine Juvenile Finfish Survey; spring spawning stock survey; spring tagging; commercial pound net, haul seine, hook and line, and drift gill net; and recreational Susquehanna Flats catch and release, spring trophy, spring-early summer and summer-fall recreational/charter boat seasons. Monitoring requirements may be changed as necessary. Data collected from Federal waters is coordinated with NOAA Fisheries. Addendum I to Amendment 6 of the ASMFC FMP requires commercial and recreational catch, bycatch, discard, and mortality data. Discard mortality data gaps will be identified. Coastal stock data was used in a VPA model but is now used in an SCA model. Addendum I to Amendment 6 of ASMFC FMP requires states to address bycatch and angler education. States are required to collect commercial and recreational catch and bycatch data that is consistent with ACCSP standards, coordinate data collection from Federal waters with NOAA Fisheries, and review discard mortality studies for information gaps. States are to implement angler education about best practices for catch and release fishing. MD Senate Bill 414 and House Bill 396 authorize NRP officers to inspect licensed commercial vessels, vehicles, and premises where MD fishery resources may be stored. NRP officers are authorized to issue electronic citations. The law allows MD DNR to suspend or revoke a license after providing the opportunity for a hearing.
	2.5.2 The District of Columbia will conduct an angler survey to determine striped bass fishing effort and harvest.	Continue	Department of the Environment conducts monthly angler surveys.
2.6.1 The District of Columbia, Maryland and Virginia will establish regulatory procedures that allow for: 1) recognition of and incorporation of ASMFC requirements into state management, and 2) a periodic cycle of public review of management options. The Potomac River Fisheries Commission will promulgate regulations	2.6.1 Maryland will propose legislation to authorize timely management actions and will develop guidelines for regulations. Virginia will promulgate regulations for timely management and seek legislation to correct any deficiencies if noted.	1990 Continue	Jurisdictions are in compliance with ASMFC and are coordinating through the Chesapeake Bay Program.
	2.6.2 The District of Columbia, Maryland, the Potomac River Fisheries Commission	Continue	ASMFC's Law Enforcement Committee develops minimum enforcement policies.

necessary to comply with the ASMFC and Chesapeake Bay Striped Bass Management Plans.	and Virginia will adopt consistent enforcement policies for the striped bass fishery throughout the Chesapeake Bay. Strategies to address enforcement needs will be developed.	2011 2011 Continue	Additional enforcement resources have been made available. Resources include additional officers, equipment, access to state-of-the-art surveillance tools, legislation and regulation, increased penalty system, and a streamlined judicial framework. MD Senate Bill 635 and House Bill 1154, require the revocation of an individual's commercial fishing license if found by an Administrative Law Judge to have knowingly committed an egregious violation or repeat violation against striped bass including: using illegal gear; harvesting during closed seasons; harvesting from a closed area; violating established harvest, catch or size limits; or violating tagging and reporting requirements.
3 - Stock Assessment and Research Needs: The Chesapeake Bay Stock Assessment Committee (CBSAC) will continue to improve the coordination of stock assessment pursuant to the Chesapeake Bay Stock Assessment Plan. Stock identification studies should be expanded, especially for the Chesapeake & Delaware Canal and along the coast, to provide information on stock mixing. The contribution of hybrids and hatchery produced fish to the wild population needs to be determined. A review of hooking mortality and other by-catch mortality rates would allow greater precision in establishing fishing mortality controls. Studies on larval survival and growth in relation to environmental variables would provide a better understanding of the factors affecting year class strength.		 Continue Completed 2009 2008 – 2011 2012-2013 2014 2015	MD and VA have instituted tagging programs to estimate migration and mortality rates. Gill net survey is used to collect population data. Studies demonstrating the effectiveness of circle hooks for reduced gut hooking and release mortality have been completed. Research has linked striped bass recruitment with climate cycles. Wood & Austin, 2009, Synchronous multidecal fish recruitment patterns in Chesapeake Bay, USA. SARC determined stock is not overfished and is not undergoing overfishing. A benchmark stock assessment was completed in 2013. An update to the benchmark stock assessment was completed and the stock was not overfished and overfishing was not occurring, but management triggers were met and led to approval of Addendum IV. An update to the stock assessment was completed in October 2015 (using data through 2014). The stock was not overfished and overfishing was not occurring, however, SSB was projected to fall below the threshold level and harvest reductions were triggered.

		2016	An update to the stock assessment was completed in October 2016 (using data through 2015). The stock was not overfished and overfishing was not occurring. Fishing mortality was 0.16, below the target of F=0.18.
		2018	A new ASMFC benchmark stock assessment is expected to be completed by the end of 2018.
		2019	A benchmark stock assessment was completed in April 2019 (using data through 2017). The stock was overfished and overfishing was occurring. Fishing mortality was 0.31, above the target and threshold levels of F.
		2022	A stock assessment update will be conducted in 2022.
3.1 The jurisdictions will continue to obtain stock information on striped bass in Chesapeake Bay.	3.1 The District of Columbia will continue monitoring aspects of striped bass population dynamics. Maryland will continue surveys of the spawning and premigratory striped bass stock in the Chesapeake Bay. Virginia will initiate surveys on its spawning stock of striped bass. Collection of tissue and scale samples to augment tagging information and stock identification will be considered.	Continue	MD has a gill net survey to monitor the spring spawning stock.
		Continue	MD and VA tag fish for the USFWS Cooperative Coastal Striped Bass Tagging Program to monitor migratory and resident striped bass population dynamics. ASMFC does not require DC to tag fish.
3.2 Efforts will be made to improve our understanding of factors that affect reproduction and recruitment to the fishery.	3.2 The District of Columbia, Maryland and Virginia, in cooperation with federal agencies, will review and update existing data, and initiate new studies that target: striped bass reproduction and early life history, especially in relation to environmental parameters; natural mortality; and catch-release mortality induced by various fishing methods.	2007 Continue	Addendum I to Amendment 6 of the ASMFC FMP requires states to implement angler education about catch and release best practices**.**
		2009 Continue	Tagging data indicates striped bass natural mortality (M) may be increasing unless CB emigration has increased. Increased M may reflect an increased incidence of mycobacteriosis, decreased prey availability, or poor water quality.
		Continue	Tagging study design and implementation requirements are coordinated with ASMFC. Tag return data provide information on migration rates and mortality. The data is then used to improve management measures.
4 – Declining Water Quality: Adequate spawning and nursery areas with good water quality are critical for striped bass survival. Although causes	4.1 The first four action items are commitments under the 1987 Chesapeake Bay Agreement. The DCFM, MD DNR,	1990 Continue	Water quality issues are also addressed in the Chesapeake 2000 Agreement and most recently in the 2009 Executive Order.

for the decline in reproduction may differ between years and between spawning areas, several water quality aspects are identified as reducing survival of young. State and Federal studies will continue to examine the effects of environmental contaminants on striped bass. 4.1 Identify those water quality factors, both natural and man-induced, which affect striped bass reproduction and survival, and focus on the control of those factors.	PRFC and VMRC are not the agencies responsible for carrying out the actual commitments but are involved in setting the objectives of the programs to fulfill the commitments. The achievement of these commitments will lead to improved water quality and enhanced biological production that can only benefit striped bass populations. The DCFM, MD DNR, PRFC and VMRC fully support these commitments.	2010 2014 Continue	EPA established a Chesapeake Bay TMDL "pollution diet" mandating nutrient and sediment reductions for compliance with the Clean Water Act. Chesapeake Bay jurisdictions adopted a new Chesapeake Bay Watershed Agreement which outlines new goals and outcomes for protecting and restoring the Bay. The document is available at .http://www.chesapeakebay.net/chesapeakebaywatershedagreement/page The forage outcome and work plan are particularly important for striped bass. A new workplan was developed for 2018-2019.
	4.1 1 - The first commitment adopted under the 1987 Chesapeake Bay Agreement was a report titled, "Habitat Requirements for Chesapeake Bay Living Resources". This document listed the habitat requirements for selected target species including striped bass. The report is being revised and updated by a workgroup of the Living Resources Subcommittee. When complete in May 1990, the habitat requirements contained in the report will be used to aid managers in improving water quality: a) Assist in the revision of water quality standards and criteria as needed, b) Develop a Habitat Requirements Use Report which will detail resource needs by river segment, c) Assist in the 1991 Nutrient Re-evaluation by providing living resource habitat requirement for use in the 3-D Model (The model will compare existing water quality with the habitat requirements and project whether the requirements would be met under various nutrient removal scenarios), and d) Assist in the implementation of the nutrient, toxics and conventional pollutant control strategies by identifying critical habitat needs.	1991 2001 2007 Completed 1990 Continue	Document published. CB jurisdictions have implemented management strategies to protect striped bass habitat. MD spawning areas are protected from harvest March through May. An ecosystem-based fishery management process was facilitated by MD Sea Grant. Habitat issues/stressors were defined for striped bass. Chesapeake Bay Program develops, revises, and monitors goals and strategies for living resources (blue crab, menhaden, oyster, shad, and striped bass. For more information: https://www.chesapeakebay.net/issues/whats-at-risk/blue-crabs https://www.chesapeakebay.net/issues/whats-at-risk/menhaden https://www.chesapeakebay.net/issues/whats-at-risk/oysters https://www.chesapeakebay.net/issues/whats-at-risk/shad https://www.chesapeakebay.net/issues/whats-at-risk/striped-bass

	4.1 2 –Development and adoption of a basinwide plan that will achieve a reduction of nutrients entering the Chesapeake Bay: a) Construct public and private sewage facilities. b) Reduce the discharge of untreated or inadequately treated sewage. c) Establish and enforce nutrient and conventional pollutant limitations in regulated discharges. d) Reduce levels of nutrients and other conventional pollutants in runoff from agricultural and forested lands. e) Reduce levels of nutrients and other conventional pollutants in urban runoff.	1990 Continue	Currently addressed through the Chesapeake Bay Program's 2-year milestones towards reaching the 2025 water quality goals. Chesapeake Bay Program develops, revises, and monitors goals and strategies for nutrient reduction. For more information: https://www.chesapeakebay.net/issues/threats-to-the-bay/nutrient-runoff
	4.1 3 – Development and adoption of a basinwide plan for the reduction and control of toxic materials entering the Chesapeake Bay system from point and nonpoint sources and from bottom sediments: a) Reduce discharge of metals and organic compounds from sewage treatment plants receiving industrial wastewater. b) Reduce the discharge of metals and organic compounds from industrial sources. c) Reduce levels of metals and organic compounds in urban and agricultural runoff. Reduce chlorine discharges to critical finfish areas.	1990 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for chemical contaminants. For more information: https://www.chesapeakebay.net/issues/threats-to-the-bay/chemical-contaminants
	4.1 4 – Development and adoption of a basinwide plan for the management of conventional pollutants entering the Chesapeake Bay from point and nonpoint sources: a) Manage sewage sludge, dredge spoil and hazardous wastes. b) Improve dissolved oxygen concentrations in the Chesapeake Bay	1990 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for sediment, wastewater, stormwater runoff, and agriculture. For more information: https://www.chesapeakebay.net/issues/threats-to-the-bay/sediment-runoff https://www.chesapeakebay.net/issues/threats-to-the-bay/wastewater https://www.chesapeakebay.net/issues/threats-to-the-bay/stormwater-runoff

	through the reduction of nutrients from both point and nonpoint sources. c) Continue study of the impacts of acidic conditions on water quality. d) Manage groundwater to protect the water quality of the Chesapeake Bay. e) Continue research to refine strategies to reduce point and nonpoint sources of nutrient, toxic and conventional pollutants in the Chesapeake Bay.		
	4.1 5 – The development and adoption of a plan for continued research and monitoring of the impacts and causes of acidic atmospheric deposition into the Chesapeake Bay and its tributaries. This plan is complemented by Maryland's research and monitoring program on the sources, effects, and control of acid deposition as defined by Natural Resources Article Title 3, Subtitle 3A, (Acid Deposition: Sections 3-3A-01 through 3-3A-04): a) Determine the relative contributions to acid deposition from various sources of acid deposition precursor emissions and identify any regional variability. b) Assess the consequences of the environmental impacts of acid deposition on water quality. c) Identify and evaluate the effectiveness and economic costs of technologies and mitigative techniques that are feasible to control acid deposition into the Chesapeake Bay.	1990 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for air pollution. For more information: https://www.chesapeakebay.net/issues/threats-to-the-bay/air-pollution

Acronyms

ACCSP – Atlantic Coastal Cooperative Statistics Program
ASMFC – Atlantic States Marine Fisheries Commission
BRP – Biological Reference Points
CB – Chesapeake Bay
CBP – Chesapeake Bay Program
CBSAC – Chesapeake Bay Stock Assessment Committee
COMAR – Code of Maryland Regulations
DC – District of Columbia
DCFM – District of Columbia Department of Consumer and Regulatory Affairs, Fisheries Management Section
EBFM – Ecosystem-based Fisheries Management
EPA – U.S. Environmental Protection Agency
F – Fishing Mortality
FACTS™ – Fishing Activity and Catch Tracking System
FMP – Fishery Management Plan
ITQ – Individual Transferable Quota
JAI – Juvenile Abundance Index
M – Natural Mortality
MD – Maryland
MD DNR – Maryland Department of Natural Resources
MSY – Maximum Sustainable Yield
NOAA – National Oceanic and Atmospheric Administration
NRP – Maryland Natural Resources Police
PA – Pennsylvania
PRFC – Potomac River Fisheries Commission
SAFIS – Standard Atlantic Fisheries Information System
SARC – Stock Assessment Review Committee
SCA – Statistical Catch at Age
SFAC – Sport Fisheries Advisory Commission
SSB – Spawning Stock Biomass (females)
TFAC – Tidal Fisheries Advisory Commission
TMDL – Total Maximum Daily Load
USFWS – U.S. Fish and Wildlife Service
VA – Virginia
VMRC – Virginia Marine Resources Commission
VPA – Virtual Population Assessment
YOY – Young of Year

2021 Maryland FMP Report (December 2022)
Section 18. Summer Flounder (*Paralichthys dentatus)*

The Mid-Atlantic Fishery Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission's (ASMFC) Summer Flounder, Scup, and Black Sea Bass Board (Board) approved changes to the commercial and recreational allocations of summer flounder, scup, and black sea bass during a joint meeting in Annapolis, Maryland in December of 2021. These changes are intended to better reflect the current understanding of the historic proportions of catch and landings from the commercial and recreational sectors. The new allocations are 55% commercial and 45% recreational and will take effect in January of 2023.

Fishery Management Plans (FMPs)

In 1991, the Chesapeake Bay jurisdictions adopted the Chesapeake Bay Summer Flounder Fishery Management Plan (CBSF FMP). The CBSF FMP implemented management measures to reduce fishing mortality (F), and increase the spawning stock biomass (SSB). The CBSF FMP strategies and actions were based on guidelines established by ASMFC and MAFMC. As the summer flounder stock improved, the Chesapeake Bay jurisdictions developed Amendment 1 to the CBSF FMP in 1997. This amendment adopted all future reference points and quotas determined by ASMFC and MAFMC. Jurisdictions continue to implement commercial and recreational management measures as needed to meet these requirements. The CBSF FMP Amendment 1 also implemented a system of individual fishing quota (IFQ) permits for the commercial fishery. The CBSF FMP was reviewed in 2014. The Plan Review Team concluded that the CBSF FMP and amendment were appropriate for managing the resource, and recommended another review after the development of the MAFMC/ASMFC amendment.

In the late 1980s, the Atlantic coast summer flounder stock was overfished and depleted. The ASMFC developed the coastal Fishery Management Plan for Summer Flounder in 1982. The coastwide plan established a 14 inches minimum size and specified trawl net mesh size for fishing in state waters (≤ 3 miles from shore). The MAFMC developed a complementary fishery management plan for summer flounder in 1988 to govern federal waters (> 3 miles from shore). The MAFMC's FMP required fishermen to abide by the more conservative of either state or federal requirements. Summer flounder management was later consolidated into a joint ASMFC and MAFMC fishery management plan.

From 1991 to 1995, MAFMC adopted seven amendments to adjust summer flounder management actions. The ASMFC and MAFMC adopted Amendments 8 and 9 to incorporate scup and black sea bass, respectively, into the summer flounder FMP.

Between 1997 and 2007 ASMFC adopted two amendments (X and XIII) and 8 addenda (III, IV, VIII, and XV-XIX) to modify summer flounder management. In that same time period, MAFMC adopted five amendments (10-13, 15, 16, and 19) and five frameworks (1, 2, and 5-7) to modify summer flounder management. The ASMFC adopted Addendum XXV in 2014 to implement regional conservation equivalency for one year (2014). Addendums XXVI (2015), XXVII (2016) and XXX (2018) extended the regional management approach for additional years.

Regional abundance of summer flounder has shifted to an increase in larger fish further north.[1] As a result, a regional, rather than state-by-state conservation equivalency approach was implemented for summer flounder, beginning in 2016. Maryland's region includes Virginia and Delaware. All states within a region have the same size limit, possession limit, and season.

On October 19, 2020, ASMFC approved the Summer Flounder Commercial Issues Amendment 21 which changed the marginal state allocations when a commercial quota is over a threshold of 9.55 million lbs. Amendment 21 was implemented beginning January 1, 2021. When the annual coastwide commercial quota is at or below 9.55 million lbs, the formula for allocating the quota to the states will remain status quo, i.e., the same state-specific percentages that have been in effect since 1993. When the annual coastwide quota exceeds 9.55 million lbs, the first 9.55 million lbs is distributed according to the status quo allocations, and the additional quota above 9.55 million lbs will be distributed as follows: 0.333% to the states of Maine, New Hampshire, and Delaware and 12.375% to the remaining states. As a result, state allocations will vary over time based on overall stock status and the resulting coastwide commercial quotas.

Stock Status

A stock assessment approved in 2019 indicated the stock is not overfished and overfishing was not occurring relative to the biological reference points.[2] In 2021 the coastal commercial quota was 12.49 million lbs and the recreational harvest limit was 8.32 million lbs.

Management Measures

The National Marine Fisheries Service (NMFS), in conjunction with MAFMC, determines coastwide annual catch limits (ACL), commercial quota, and recreational harvest limit (RHL). Commercial coastwide quota is allocated among states based on their historic proportion of landings. Maryland is allocated 2.04% of the coastwide commercial quota until the 9.55 million lbs threshold is reached; then Maryland will receive 12.375% of the remaining coastal quota. Maryland receives 2.9% of the recreational harvest limit. States can implement conservation equivalency that may

result in different regulatory combinations from state-to-state as long as they stay within the ACL. Commercial and recreational quota overages are deducted from the following year's quota.

Maryland implements catch share management to equitably distribute the commercial quota among harvesters in Atlantic coastal waters, coastal bays and tributaries, the Chesapeake Bay (primarily bycatch) and the Potomac River. The catch share system assigns a specific IFQ to each fisherman, which allows them to manage their business for best economic yield. Commercial hook and line harvest is managed with a 16.5 inches minimum length, and all other gears have a 14 inches minimum length. Commercial fishermen without an IFQ are restricted to 100 lbs per person per day in coastal waters and 50 lbs per person per day in Chesapeake Bay tidal waters. The commercial season is year-round. The Potomac River Fisheries Commission manages the Potomac River with a 14 inches minimum size. Net design and mesh size are also regulated.

For the Maryland/Delaware/Virginia (MDV) region, the minimum recreational size was 16.5 inches with a limit of 4 fish per person per day. The fishery was open year-round in 2017 through 2021.[3]

Maryland monitors summer flounder abundance, size, and age with two independent annual surveys in the coastal bays (Beach Seine and Trawl surveys). The results from these surveys are used by ASMFC, MAFMC, and Maryland to monitor the fishery and develop regulations for the following year's summer flounder fisheries.

The Fisheries

The preliminary Maryland commercial harvest in 2021 was 347,116 lbs (Figure 1; Maryland commercial logbooks).

Maryland's 2021 recreational catch of summer flounder was estimated at 68,757 fish (PSE 21.6) with an estimated total weight of 192,796 lbs (PSE 32.2; Personal Communication from the National Marine Fisheries Service, Fisheries Statistics Division. Accessed April 21, 2022) (Figure 2).[4]

Issues/Concerns

Commercial harvesters from the lower mid-Atlantic have been traveling further northward to catch summer flounder. For example, harvesters from North Carolina will travel by boat to New Jersey. The commercial sector has requested permission to land summer flounder at a port located where they are fishing, rather than traveling back to their home port. A potential consequence of such a change could possibly be a reallocation of state commercial quotas.

Figure 1. Maryland commercial summer flounder harvest in pounds, 1958-2021. (Source: Maryland catch records)

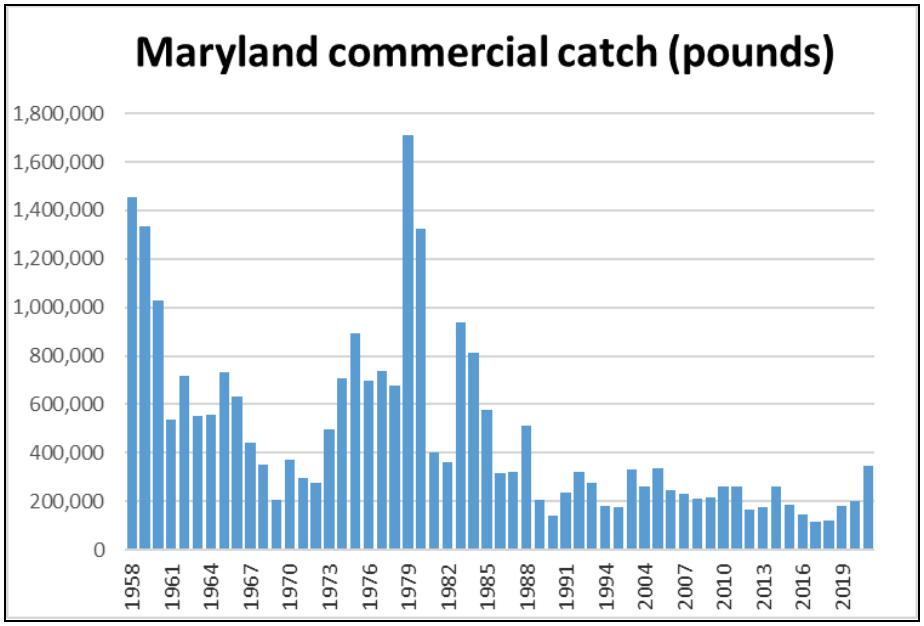
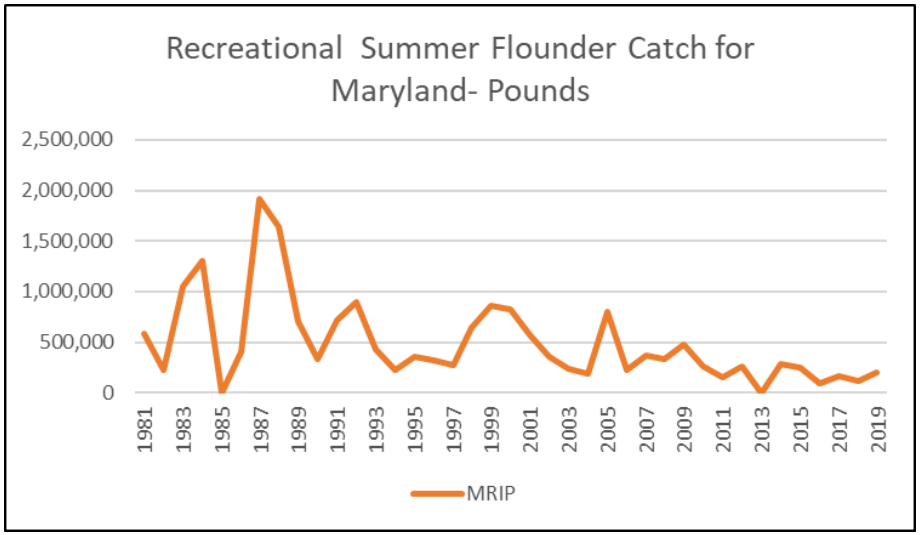


Figure 2. Estimated recreational summer flounder harvest in pounds, 1981-2021 (MRFS and MRIP).



References

[1] Atlantic States Marine Fisheries Commission. 2015. Addendum XXVI to the Summer Flounder, Scup, Black Sea Bass Fishery Management Plan. Arlington, Virginia.

[2] Northeast Fisheries Science Center. 2019a. 66th Northeast Regional Stock Assessment Workshop (66th SAW) Assessment Report. US Dept Commerce, Northeast Fish Science Center Ref Doc. 19-08; 1170 p.

[3] Doctor, S. 2022. Maryland's 2021 summer flounder (*Paralichthys dentatus*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources, Annapolis, Maryland. NEFSC.

[4] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. http://www.st.nmfs.noaa.gov/index. Accessed April 21, 2022.

Amendment #1 to the 1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table			
Strategy	**Action**	**Date**	**Comments**
1.1) The Bay jurisdictions will continue to implement management measures which reduce fishing mortality on the summer flounder stock and equitably allocate the harvest of summer flounder.	1.1a) The jurisdictions will implement annual quotas, individual quotas and/or possession limits, in addition to seasonal restrictions, minimum mesh size requirements, minimum size limits, limited entry and license requirements to meet the coastwide commercial quota. The traditional balance of harvest between the Chesapeake Bay and the Atlantic coast will be maintained.	1998 2004 Continue	The ASMFC revised the overfishing definition. Coastwide and state quotas are determined annually. FMP actions are annually evaluated, and adjusted to meet the ASMFC's coastal stock rebuilding targets. The commercial quota for MD in 2017 was 115,398 lbs. The preliminary MD commercial harvest in 2017 was 112,971 lbs.
		2008 2009	The ASMFC's Summer Flounder, Scup, and Black Sea Bass Board set the 2009 total allowable landings for summer flounder at 18.45 million lbs, up 2.68 million lbs from 2008. Officials determined from the 2008 June Stock Assessment Workshop (SAW) and Peer Review that summer flounder is no longer overfished, is not experiencing overfishing, but has not been rebuilt to target levels.
		2011 Continue	The MD annual commercial quota is determined by the NMFS/ASMFC. Commercial IFQ permits are issued. Limit without permit in the Ocean/Coastal Bays is 100 lbs/person/day. Limit without permit in The Chesapeake Bay is 50 lbs/person/day. The PRFC's annual commercial quota is determined by the NMFS/ ASMFC and deducted from MD's total annual quota. VA's annual commercial quota is determined by the NMFS/ASMFC and is 21.3% of the coastwise quota. Of the quota, 300,000 lbs are set aside for tidal waters; 142,114 lbs for the Chesapeake Bay waters; the remaining quota is allocated to non-Virginia waters (typically >3 miles offshore). For non-VA waters, harvest from 1st Monday in Jan. to the day prior to last Mon. in Nov. is allotted 70.7% of the quota. The remaining 29.3% of the quota is allotted to the last Monday of November to December 31. Allocation limits are adjusted for over/under harvest. A series of combined pound/day and pound/species (Atlantic croaker, black sea bass, scup, squid, scallop, and Atlantic mackerel) restrictions have been implemented.
		2014-2015	MD's commercial hook & line minimum size was reduced from 16" to 14". Min. size for other gear types is 14". PRFC and VA minimum size is 14".

		2016 Continue	MD's commercial hook & line minimum size limit 16". Minimum size limit for all other commercial gear was 14".
		2019 Continue	MD's commercial hook & line minimum size limit 16.5". Minimum size limit for all other commercial gear was 14".
	1.1b) The jurisdictions will implement recreational seasons, creel limits and minimum size limits to meet the annual coastal recreational harvest limits recommended by the MAFMC/ASMFC.	2001	The ASMFC implements a coastwide system for conservation equivalency.
		2003	The ASMFC sets State-specific recreational harvest targets.
		2005	The ASMFC established a program to allow the recreational summer flounder coastwide allocations to be subdivided into regions.
		2014	Regional management was implemented in place of conservation equivalency. MD, DE, and VA are being managed as a single region, with all jurisdictions having the same regulations: 16" minimum length and 4 fish/person/day creel.
		2015 Continue	Regional management in effect. MD/DE/VA all have the same minimum size limit, creel limit for the recreational fishery.
	1.1c) Maryland and Virginia will maintain the traditional commercial fishery by requiring a special landings permit for the Atlantic commercial summer flounder fishery. The jurisdictions will develop, define and adopt criteria to determine eligibility for participation in the fishery.	1998 2003 Continue	MD has implemented a summer flounder catch share system. The catch share allocation equitably distributes the quota among harvesters, based on past harvest. The IFQ allows fishermen to manage harvest for best economic yield.
		2005 Continue	VA issues permits for vessels and dealers.

1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table			
Strategy	**Action**	**Date**	**Comments**
1.1) Maryland, Virginia and the PRFC will propose changes in the minimum size regulations, creel limits and seasons in the recreational fishery, to conform to guidelines set by the MAFMC. Maryland and Virginia will comply with commercial quotas, mesh sizes and other commercial restrictions enacted by the MAFMC. These recommendations are intended to provide greater spawning stock biomass from each flounder year-class and provide a greater yield-per-recruit.	1.1a) Maryland, the PRFC and Virginia will propose an increase in their minimum size limit for recreationally caught flounder from 13 inches to 14 inches.	1992 1998	Initiated increasing minimum size 13" to 14" the ASMFC revised overfishing definition. See Amendment #1, Strategy 1.1, Action 1.1b
	1.1b) Maryland, Virginia and the PRFC will propose creel limits and seasonal restrictions in compliance with the MAFMC's recommendations. A six fish creel limit will be proposed as one measure to meet these recommendations. A recreational fishing season extending from May 15 – Sept. 30 may also be required to reduce fishing mortality. Virginia will continue to enforce its ten fish per day limit until such time as the MAFMC's recommendations can be implemented.	1998	See Amendment #1, Strategy 1.1, Action 1.1b
	1.1c) Commercial size limits will remain at 13" for Virginia and Maryland in conformance with the MAFMC's recommendations. The PRFC will propose a 14" minimum commercial size limit for its commercial flounder fisheries to provide parity with the recreational fishery. A 5.5-inch diamond or 6-inch square minimum cod end mesh size will be implemented in all directed flounder trawl fisheries.	1998	See Amendment #1, Strategy 1.1, Action 1.1a
	1.1d) Commercial fisheries will be subject to quotas set by the MAFMC, and administered by the states. All flounder landed by a vessel registered in a state will be counted towards that state's quota, without regard to the actual fishing location. Commercial fisheries in each state will be closed when that state's quota is reached. The PRFC will propose a moratorium on its commercial flounder fisheries from January through June, inclusive, to complement the seasonal closure proposed for the recreational fishery, in addition to conforming to the MAFMC's quota closures.	1993 1995 1998 2012 2013	The ASMFC's State allocations changed. The ASMFC capped coastwide quota & adjusted stock rebuilding schedule. The ASMFC revised the overfishing definition. See Amendment #1, Strategy 1.1, Action 1.1a MD receives 2.04% of the coastwide commercial TAL. A portion of MD's TAL is allocated to the PRFC. VA is allocated 21.3% of the coastwide quota. A coastwide benchmark stock assessment was completed in 2013 (with data through 2012). Updated BRPs were adopted. The coastal summer flounder stock is not overfished and overfishing is not occurring.

		2014 Continue	The MAFMC began a major review of the summer flounder component of their management framework.
		2017	The 2013 benchmark stock assessment was updated in 2015 and 2016. Based on the 2016 update, the summer flounder stock is not overfished, but overfishing is occurring. A 2018 benchmark stock assessment is currently in progress, and is slated for completion in fall 2018. Preliminary results indicate overfishing is no longer occurring.
		2019	An operational assessment update was completed and it indicated that the stock is not overfished and overfishing is not occurring. The assessment included new MRIP values.
		2021	The recreational/commercial allocation split will be changed to 55% commercial and 45% recreational beginning January 2023.
1.2) Management agencies will continue to promote the implementation of minimum mesh size in the directed flounder trawl fisheries, sufficient to allow escapement of immature female flounder. Management agencies will urge the Mid-Atlantic Fisheries Management Council to enact a mesh size compatible with these management goals in the directed flounder trawl fisheries to complement the mesh size requirements enacted through the Baywide Plan.	1.2a) Virginia and Maryland will implement a 5.5-inch diamond or 6-inch square minimum cod end mesh size in all directed flounder trawl fisheries to allow escapement of immature female flounder. Virginia and the PRFC will continue their bans on trawling in state waters.	Completed Continue	Mesh size restrictions have been implemented.
	1.2b) Virginia and Maryland will work with the Mid-Atlantic Fisheries Management Council to adopt a 5.5-inch diamond or 6-inch square minimum cod end mesh size for the EEZ flounder trawl fishery consistent with the objectives of the Baywide Plan and MAFMC's recommendations for conservation of the resource.	Continue 2014 Continue	Mesh size restrictions have been implemented. The MAFMC has begun a major review of their management framework for summer flounder.
1.3) Virginia, Maryland and the Potomac River Fisheries Commission will investigate the incidental bycatch of small flounder in non-directed fisheries, and participate in coastal deliberations to protect small flounder in other coastal states.	1.3a) Maryland will collect information from its pound net and ocean trawl fisheries to develop management strategies for reducing the non-directed bycatch of small flounder and other species. Options for consideration include minimum mesh sizes, season and area restrictions, culling practices, escape panels and fishing efficiency devices.	Continue	MD collects summer flounder abundance, size, and age data from commercial trawlers fishing near-shore Atlantic waters.
	1.3b) Virginia will continue to monitor the species composition and biological characteristics of bait harvested in its pound net fishery. The VMRC will take action, as needed, to reduce the incidental	Continue	Monitoring of pound net bait fish harvest is not required.

	bycatch of small flounder in the bait fishery.		
	1.3c) Maryland, the PRFC, and Virginia will work through the Mid-Atlantic Fisheries Management Council and the Atlantic States Marine Fisheries Commission to encourage protection of immature flounder.	Continue	Immature flounder are conserved via gear and harvest restrictions.
2.1) Maryland, Virginia and the Potomac River Fisheries Commission will continue to support stock identification research to determine the extent of stock mixing in the Chesapeake Bay flounder population.	2.1) The jurisdictions will continue to support stock identification research, particularly stock composition tagging studies being conducted at the Virginia Institute of Marine Science (VIMS) and the University of Maryland. Coordinated studies on the relative contribution of various estuaries, including the Chesapeake Bay, to the coastal flounder stock will be initiated.	1995 Continue 2014 Continue	The VIMS and the VMRC cooperatively support the Virginia Game Fish Tagging Program. The tagging program trains and maintains an experienced group of volunteer recreational anglers who tag and release the fish they catch. More information is available at: http://www.vims.edu/research/units/centerspartners/map/recfish/index.php MD does not have a summer flounder tagging program. Regional stock management for the recreational fishery including Delaware, Virginia, PRFC and Maryland was implemented for 2014 and continued into **2021**
2.2) Virginia will continue to support stock assessment work conducted by the VMRC, and index of abundance research performed by the Virginia Institute of Marine Science (VIMS).	2.2) The VMRC's Stock Assessment Program will continue to collect biological data (age, size, sex) from commercial catches of summer flounder. The VIMS will continue to monitor abundance of juvenile flounder through its young-of-the-year and juvenile flounder survey trawl indices.	Continue	Data collection is required by the ASMFC and MAFMC.
2.3) Maryland, Virginia and the Potomac River Fisheries Commission will continue to support interjurisdictional efforts to maintain a comprehensive data base on coastwide level.	2.3) Maryland, Virginia and the PRFC will continue to collect fisheries landings data on summer flounder as part of ongoing commercial fisheries statistics programs. Virginia will continue to pursue adoption and implementation of a limited and/or delayed entry program and a mandatory reporting system for commercial licensees. Maryland and Virginia will continue to supplement the Marine Recreational Fisheries Statistics Survey to obtain more detailed catch statistics at the state level. Through FISHMAP, Maryland will begin a pound net sampling project to collect information on summer flounder and other species.	Continue 2006	Data collection is required by the ASMFC and theMAFMC. The FISHMAP program was discontinued.
2.4) Maryland and Virginia will continue their joint and individual efforts in providing the information	2.4) Maryland and Virginia will continue the Baywide trawl survey of estuarine finfish species and crabs to measure size, age, sex distribution,	1977 Continue	MD DNR conducts a summer blue crab trawl survey.

needed to determine the relationship between abundances of adult and juvenile flounder.	abundance and CPUE. Maryland will continue seaside juvenile summer flounder studies utilizing bottom trawls, beach seines and their cooperative sampling of trawl fisheries.	1989 Continue	VIMS and MD DNR collaboratively conduct a winter dredge survey of blue crabs.
		2001 2006	University of Maryland Center for Environmental Science Chesapeake Biological Laboratory, University of Maryland - College Park, and the MD DNR cooperatively conduct the Chesapeake Bay Fishery-Independent Multispecies Survey (ChesFIMS). More information is available at: http://hjort.cbl.umces.edu/chesfims.html
		2002 Continue	VIMS conducts the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP, a subset of ChesFIMS sites) with funding from the VMRC. The trawl survey samples juvenile and adult fishes from the upper Chesapeake Bay to the mouth of the Bay.
		2006 Continue	Northeast Area Monitoring and Assessment Program (NEAMAP) is a near shore trawl survey that samples from Cape Hatteras north to Cape Cod was implemented. More information is available at: https://www.vims.edu/research/units/programs/multispecies_fisheries_research/neamap/
		Continue	Summer flounder juvenile surveys are required by ASMFC.
3.1) The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to promote the commitments of the 1987 Chesapeake Bay Agreement. The achievement of the Bay commitments will lead to improved water quality and enhanced biological production.	3.1) The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to set specific objectives for water quality goals and review management programs established under the 1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement call for: 1) Developing habitat requirements and water quality goals for various finfish species.	1990 Continue	The Chesapeake Bay Program (CBP) develops, revises, and monitors goals and strategies for agriculture, air pollution, bay grasses, blue crabs, chemical contaminants, climate change, development, education, forests, groundwater, invasive species, menhaden, nutrients, oysters, population growth, rivers and streams, sediment, shad, stormwater runoff, striped bass, wastewater, weather, and wetlands. For more information: http://www.chesapeakebay.net/issues
		2014 Continue	The CBP has developed a Chesapeake Watershed Agreement (2014) with fisheries and habitat outcomes. Summer flounder is not a focal species. However, diet analysis indicates summer flounder in the Chesapeake Bay are eating mysids, Bay anchovies, sand shrimp and mantis shrimp.
		2020	The Maryland Coastal Bays Program (MCBP) is a National Estuary Program which exists to protect and conserve the waters and surrounding watershed of Maryland's coastal bays to

			enhance their ecological values and sustainable use for both present and future generations. Through education and outreach programs, numerous restoration projects, and local partnerships, MCBP works to improve water quality, protect habitat, and enhance forests and wetlands. Projects have included: wetland creation on an abandoned sand gravel mine that annually removes over 1,000 lbs of nitrogen from entering the St. Martin River; restoration of eroding shoreline eroding shoreline at Assateague State Park that was estimated to annually remove 44 lbs of nitrogen, 3 lbs of phosphorus, and 164 tons of sediment from Sinepuxent Bay; numerous stormwater retrofits that reduce nitrogen and phosphorus in stormwater from entering the coastal bays; and restoration of hydrology to allow better stormwater infiltration into the headwaters of Ayers Creek, Newport Bay. Projects have also included restoration of fish passage to freshwater spawning grounds of anadromous fishes.
	3.1 2) Developing and adopting basinwide nutrient reduction strategies.	1990 Continue	The Chesapeake Bay Program develops, revises, and monitors goals and strategies for nutrient reduction. For more information: https://www.chesapeakebay.net/issues/threats-to-the-bay/nutrient-runoff
	3.1 3) Developing and adopting basinwide plans for the reduction and control of toxic substances.	1990 Continue	The Chesapeake Bay Program develops, revises, and monitors goals and strategies for chemical contaminants. For more information: https://www.chesapeakebay.net/issues/threats-to-the-bay/chemical-contaminants
	3.1 4) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and nonpoint sources.	1990 Continue	The Chesapeake Bay Program develops, revises, and monitors goals and strategies for sediment, wastewater, stormwater runoff, and agriculture. For more information: https://www.chesapeakebay.net/issues/threats-to-the-bay/sediment-runoff https://www.chesapeakebay.net/issues/threats-to-the-bay/wastewater https://www.chesapeakebay.net/issues/threats-to-the-bay/stormwater-runoff
	3.1 5) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system.	1990 Continue	The Chesapeake Bay Program develops, revises, and monitors goals and strategies for air pollution. For more information: https://www.chesapeakebay.net/issues/threats-to-the-bay/air-pollution
	3.1 6) Developing management strategies to protect and restore wetlands and submerged	1990 Continue	The Chesapeake Bay Program develops, revises, and monitors goals and strategies for wetland and submerged aquatic

	aquatic vegetation.		vegetation restoration. For more information: https://www.chesapeakebay.net/issues/whats-at-risk/wetlands https://www.chesapeakebay.net/issues/whats-at-risk/underwater-grasses
	3.1 7) Managing population growth to minimize adverse impacts to the Bay.	1990 Continue	The Chesapeake Bay Program develops, revises, and monitors goals and strategies for land development. For more information: https://www.chesapeakebay.net/issues/threats-to-the-bay/development

Acronyms

ASMFC – Atlantic States Marine Fisheries Commission
CBP – Chesapeake Bay Program
ChesFIMS – Chesapeake Bay Fishery-Independent Multispecies Survey
ChesMMAP – Chesapeake Bay Multispecies Monitoring and Assessment Program
CPUE – Catch per Unit Effort
EEZ – Exclusive Economic Zone
FISHMAP – Fishery Independent Sampling and Habitat Mapping
FMP – Fishery Management Plan
IFQ – Individual Fishing Quota
MAFMC – Mid-Atlantic Fishery Management Council
MD – Maryland
MD DNR – Maryland Department of Natural Resources
NEAMAP – Northeast Area Monitoring and Assessment Program
NMFS – National Marine Fisheries Service
PRFC – Potomac River Fisheries Commission
SAW – Stock Assessment Workshop
TAL – Total Allowable Landings
VA – Virginia
VAC – Code of Virginia
VIMS – Virginia Institute of Marine Science
VMRC – Virginia Marine Resource Commission

2021 Maryland FMP Report (December 2022)
Section 19. Tautog (*Tautoga onitis*)

Maryland has a world class recreational fishery for tautog and these fish must be carefully managed in Maryland due to their structure-oriented nature which can make them easy to harvest, combined with their slow growth rate and long lifespan which can hinder recovery from overexploitation. Tautog are distributed along the northeast Atlantic coast and are currently most abundant from Cape Cod to Cape Hatteras. They inhabit coastal and estuarine waters throughout this range. Tautog are attracted to structure in all post larval stages of their life cycle. Adult tautog migrate inshore from offshore wintering locations to spawn between April and July. The eggs and larva drift toward coastal estuaries. Age 0 or young-of-year tautog can be found in SAV beds. Tautog typically migrate offshore when water temperatures drop below approximately 50°F in the late fall, although seasonal migration is not uniformly exhibited. Some adults remain inshore and active throughout the year, particularly in the southern portion of the range. The species' distribution, behavior and, perhaps, growth and survival, are related to its high dependence on blue mussels. A significant decline in the availability of blue mussels can cause tautog to abandon a particular area.[1]

Fishery Management Plans (FMPs)

The Chesapeake Bay and Atlantic Coast Tautog Fishery Management Plan (CBT FMP) was adopted in 1998 by the Chesapeake Bay Program (CBP). The Bay jurisdictions agreed to reduce exploitation, and improve protection of the spawning stock in the Chesapeake Bay and the Atlantic coast by complying with the Atlantic States Marine Fisheries Commission's (ASMFC) recommendations. Habitat degradation is addressed through multiple strategies that improve structure, submerged aquatic vegetation (SAV), and water quality. The CBT FMP was reviewed in 2011, and resulted in the conclusion that the current management framework is appropriate for managing the stock.

Tautogs have been managed under an ASMFC Fishery Management Plan for Tautog since 1996. Fishing pressure in the mid-1980s through early 1990s and tautog's vulnerability to overfishing led to the development of the coastwide FMP. The goal of the plan was to conserve the resource along the Atlantic coast and maximize long-term ecological benefits while maintaining the social and economic benefits of the recreational and commercial fisheries. Over the years, Addenda I-VI (1997, 1999, 2002, 2007, and 2012) and Amendment 1 (2017) have modified the plan.

Amendment 1 to the Interstate Fishery Management Plan for Tautog replaced the original FMP and addenda. The amendment includes new management goals and objectives, biological reference points, fishing mortality targets, and stock rebuilding schedules. Since tagging data indicated strong site fidelity across years, with limited north-south movement and some seasonal inshore-offshore migrations,[1] a regional management approach has been delineated. The amendment defines four regions based on differences in biology and fishery characteristics: Massachusetts-Rhode Island (MARI); Long Island Sound (LIS); New Jersey-New York Bight (NJ-NYB), and Delaware-Maryland-Virginia (DelMarVa). In addition, the amendment created a commercial harvest tagging program that was implemented in January 2020 to address illegal harvest.

Stock Status

In 2021, a Regional Stock Assessment Update was completed, using the same assessment methodology that was approved for management use as part of the 2016 Regional Benchmark Stock Assessment and subsequently used in the 2017 update. The 2021 Stock Assessment Update found improvements in most regions. Stocks within the LIS and DelMarVa regions are not overfished, with improved stock status for both regions from the last assessment in 2017. For LIS, NJ-NYB, and DelMarVa, fishing mortality also decreased with the stock not experiencing overfishing in any regions; also an improvement from the previous assessment. In the MARI region, stock status remains unchanged with the stock not overfished nor experiencing overfishing.

Each regional assessment used information through 2020, including calibrated recreational data from the Marine Recreational Information Program (MRIP). In addition to regional indices of abundance from fishery-independent surveys, a catch per unit effort index was developed using MRIP data for each region because tautog are not easily sampled by standard fishery-independent surveys. The new MRIP estimates resulted in higher estimates of spawning stock biomass (SSB) and recruitment in all regions, but had less of an impact on fishing mortality.

The regional assessments for MARI and LIS indicated strong year classes in recent years have contributed to increasing trends in SSB. In the DelMarVa region, landings and fishing mortality have declined significantly since 2012, resulting in an increase in SSB over the time period. While the NJ-NYB region remains overfished, the SSB has been trending upward since the last assessment update.[2]

Current Management Measures

Commercial and recreational fisheries have the same seasons, creel limits, and minimum size limit (16 inches) in Maryland. The season changed in 2017, with a conservative approach protecting spawning fish in May and June and allowing fishing in December again. In 2021 tautog fisheries in tidal and coastal waters were

limited to four fish per person per day from January 1 through-May 15, the season was closed from May 16 through June 30, reopened with a two fish creel limit from July 1 through October 31, and finished with a four fish creel from November 1 through December 31. Commercial harvesters are allowed to use hook and line, net, pot, trap, trot line, and seine. One panel on pots and traps must be attached with degradable fasteners to prevent ghost fishing if lost. Recreational anglers were restricted to hook and line. Commercial tautog must have a state harvest tag. Tagging fish will assist in the reduction of illegal fish available in the live market. [4]

The Fisheries

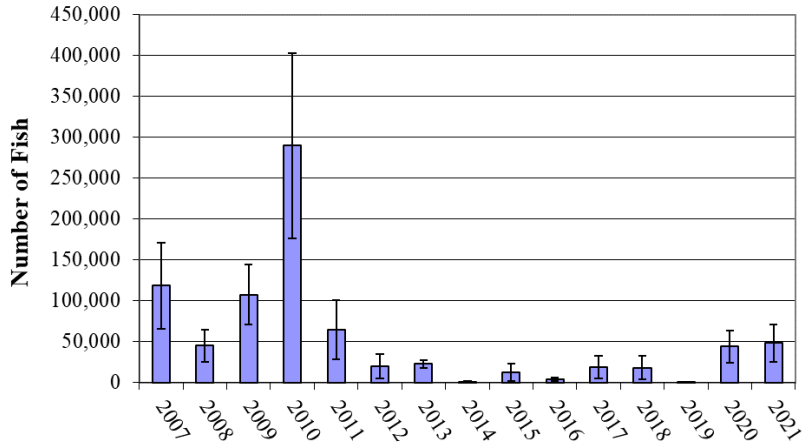
Maryland tautog fisheries are currently managed within the DelMarVa region, with the goal to have similar regulations throughout the management area. Regional management has been successful with the focus on sustainable recreational fishing, and included very limited commercial fishing. The closure from May 16 to June 30 to protect tautog spawning surely contributed to the documented increase in juvenile tautog relative abundance in Sinepuxent Bay.[5]

Previously, tautog were managed as a coastwide stock, and Maryland's recreational and commercial tautog harvests were minor components of the total coastwide landings. Tautog are not well sampled by MRIP, which results in higher percent standard errors (PSEs).[1] The final 2021 estimates from MRIP determined the total coastwide recreational harvest of 3,349,981 tautogs (numbers of fish; A+B1; PSE 9.1) whereas the Maryland estimate was 48,258 tautogs (numbers of fish; A+B1; PSE 64.4).[6] Maryland commercial landings have remained at low levels since 2007 due to the limited possession allowance. The state is considered *de minimis* by the ASMFC, and a component of these landing data are confidential.[7]

Issues/Concerns

Habitat loss, specifically SAV in the Maryland Coastal Bays, may reduce tautog recruitment success. The NOAA Fisheries Fishing Effort Survey Calibration Model has the potential of creating new estimates that may substantially affect many facets of science and management toward tautog management. The new mail-based Fishing Effort Survey (FES) uses angler license and registration information as one way to identify and contact anglers (supplemented with data from the U.S. Postal Service, which includes virtually all U.S. households). The FES replaced the Coastal Household Telephone Survey (CHTS), which uses random-digit dialing of homes in coastal counties to contact anglers.

Figure 1. Maryland recreational tautog harvest (A + B1; number of fish): 2007-2021 as estimated by the Marine Recreational Information Program.



References

[1] Atlantic States Marine Fisheries Commission. 2017. Amendment 1 to the Interstate Fishery Management Plan for Tautog. 1050 N. Highland Street, Suite 200, Arlington, Virginia 22201.

[2] Atlantic States Marine Fisheries Commission. 2021. Tautog Regional Stock Assessment Update. Arlington, Virginia 22201.

[3] Maryland Department of Natural Resources. 2021 Maryland's 2020 Tautog (*Tautoga onitis*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources, Fisheries Service, Annapolis, Maryland.

[4] Atlantic States Marine Fisheries Commission. 2021 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Tautog (*Tautoga onitis*) 2020 Fishing Year. Arlington, Virginia 22201.

[5] Doctor, S., G. Tyler, C. Weedon, and A. Willey. 2021. Investigation of Maryland's Coastal Bays and Atlantic Ocean Finfish Stocks: July 2019 - June 2020 Final Report. Federal Aid Project No. F-50-R-29. Maryland Department of Natural Resources, Annapolis, MD. 118 pp.

[6] Marine Recreational Information Program (MRIP), National Marine Fisheries Service, 2021, Fisheries Statistics Division.

[7] The Atlantic Coastal Cooperative Statistics Program (ACCSP), 2021.

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table			
Strategy	**Action**	**Date**	**Comments**
1) Implement minimum size and possession limits applicable to the commercial and recreational fisheries to prevent overexploitation. Monitor size composition of landings in the recreational fishery to prevent compression of age structure in the population. Use size composition of fish in the recreational fishery and total landings in the commercial fishery as triggers to implement further management of the fishery, should statistically significant compression of the age structure occur. This plan recommends that the Secretary of Commerce implement minimum size and possession regulations for tautog in the EEZ, that are in accordance with state minimum size requirements contained in the plan. It is the intention under the Atlantic Coastal Fisheries Conservation and Management Act to have EEZ fisheries regulated consistent with state possession and landing laws, and that the more stringent of state or federal law will apply regardless of whether fish are caught in the EEZ or in state waters.	1.1) VA, MD and the PRFC will implement a minimum size limit of 14" in the recreational and commercial tautog fisheries. Minimum size limits may be changed as more data becomes available on stock condition, and biological reference points are re-evaluated.	1998 2003 2005 2013 2018	MD commercial and recreational fisheries have a 16" minimum size, 4 fish/person/day from January 1 – May 15, 2 fish/person/day from May 16 – October 31, 4 fish/person/day from November 1 – 26, and are closed from November 27 – December 31. VA has a 16" minimum size, 3 fish/person/day creel, and a recreational closure from May 1 – Sept 19. The VA commercial fishery has a 15" minimum size, no catch limit, and seasonal closures from January 22 – last day of February and May 1 - October 31. The PRFC has a 14" minimum size limit, and no harvest restrictions for both commercial and recreational fisheries. Commercial and recreational fisheries have the same seasons, creel limits and minimum size limit in Maryland. The season changed in 2017, with a conservative approach to protect spawning fish in May and June, and allowing fishing in December. Fisheries in tidal and coastal waters were limited to 4 fish per person per day during January 1- May 15 and during November 1- December 31. Harvest was reduced to 2 fish per person per day from July 1- October 31, and the season was closed May 16 - June 30. Tautog harvest was prohibited from November 27- December 31. VA The minimum size of tautog harvested for recreational purposes shall be 16 inches in total length. It shall be unlawful for any person fishing with hook and line, rod and reel, spear, gig or other recreational gear to possess more than four tautog. The recreational fishing season shall be closed from May 16 through June 30. The minimum size limit of tautog harvested for commercial purposes shall be 15 inches in total length. The commercial fishing season shall be closed from

			January 22 through the last day of February and May 16 through October 31, and it shall be unlawful for any person to possess tautog for commercial purposes during this period. PRFC No change.
	1.2) VA, MD and the PRFC will reduce fishing mortality to interim and target rates, as defined by the ASMFC, through a combination of possession limits, gear, seasons, and/or other restrictions. Target rates may be changed and management measures adjusted, as more data becomes available to manage the stock. Due to differences in F between MD and VA, different management strategies may be necessary to reach the target F set by ASFMFC. The jurisdictions will continue to work towards a unified, Baywide management strategy.	1999 2005 2011 2012 2015 2016 2017	A benchmark coastal stock assessments and stock assessment updates have been completed over the years. The stock assessment completed in 2005 (using data from 1981-2004) indicated that F declined from 0.71 to 0.299. Overfishing was redefined as $F_{40\%SSB}$=0.29. The 3-year average (F=0.389) exceeds the ASMFC rebuilding target (F=0.2). Tautog have a SSB_{2009} of 23.5 million lbs, 20.8 million lbs below the $SSB_{threshold}$. Tautog were overfished, and overfishing was occurring. The ASMFC's Addendum VI was implemented to reduce F to 0.15, a 53% reduction, and prohibit possession of tautog caught in federal waters. MD's 2012 harvest reduction was decreased from 48% to 39%. Based on the 2014 (2015) tautog benchmark stock assessment, the stock is overfished, and overfishing is occurring.[1] Besides assessing tautog as a one-unit stock along the coast, a regional stock assessment approach was evaluated. A stock assessment update was completed in 2016, based on 4 defined regions. All regions are considered overfished, but overfishing is not occurring in the DelMarVa region. The ASMFC's Amendment 1 delineated four stock regions, based on differences in biology and fishery characteristics. A reduction in F was not required for the DelMarVa, but the region closed the fishery for 45-days during the spawning season as a conservation measure.
	1.3) VA and MD waters will continue to require degradable fasteners in tautog pots and traps utilizing either:	1997 Continue	A pot and trap shall have hinges on one panel/door made of untreated hemp or jute string 3/16" (4.8 mm) diameter or smaller, magnesium alloy fasteners or

	• Untreated hemp, jute, or cotton string of 3/16” (0.48 mm) or smaller • Magnesium alloy, timed float releases (pop-up devices) or similar magnesium alloy fasteners • Ungalvanized or uncoated iron wire of 0.09” (2.39 mm) or smaller.		ungalvanized/uncoated iron wire of 0.094" (2.39 mm) diameter.
2.1) VA and MD will work with the Virginia Institute of Marine Science, Old Dominion University, the University of Maryland, the Smithsonian Institute and the National Marine Fisheries Service’s Marine Recreational Fisheries Statistics Survey to conduct research into the size, age and sex composition of tautog in the Chesapeake Bay. The agencies’ stock assessment departments will continue to collect information on size composition to monitor the status of tautog stocks. This stock assessment data will be used to determine a baseline of age and sex distribution for the local stock, significant deviation from which will be used as a trigger mechanism to determine the need for future management measures.	2.1) The management agencies will gather data on age, size and sex distribution to be used as a baseline measurement of a healthy population, and will encourage research into the possibility of sex-reversal in the tautog population.	1989-1999 Continue 1996-2012 2013-2014 2010-2020 2019 Continue 2015-2020 Continue	Annual fecundity estimates are much higher than previously thought. All states are required to collect data to support the coastwide stock assessment. Data are collected from cooperating head boat captains, trawl, and seine. Collecting length at age and weight at age by sex data has continued with samples from the commercial landings. A DNA analysis of tautog was conducted to determine if there is genetic separation in the coastal stock. Maryland is participating in this study, results pending publication Collecting length at age and weight at age by sex data has continued with samples from the recreational charter and party boat catches. MD, VA and DE will create a regional age length key. Sex reversal in tautog has not been observed. A rack program was initiated in 2018 however, weight data is no longer collected. ASMFC Tautog Technical Committee will provide recommendations to the Board to consider non-lethal ageing structures, specifically pelvic spines, as an alternative to otolith or opercula. The age comparison study is underway, and results should be available in 2020. MD Coastal Bays Fisheries Investigation annually conducts the SAV Habitat Survey. This survey has identified juvenile tautog habitat within the coastal bays. This work is ongoing and may be included in the next ASMFC Tautog Stock Assessment.
	2.1 A) VA will continue the Baywide trawl survey of estuarine finfish species and crabs to measure size, age, sex, distribution, abundance and CPUE.	Continue	Data from the Baywide trawl survey is used in the ASMFC stock assessment. However, very little data is collected on tautog.
	2.1 B) VA implemented a mandatory reporting system for commercial licensees beginning January 1, 1993. Maryland’s mandatory reporting system has	Continue	Commercial reporting has been improved through more stringent penalties for late reporting and no reporting.

	been in effect since 1944 (excluding eel). Improved reporting of commercial landings, along with more detailed information on catch location and effort are some of the expected benefits of these programs.		MD commercial tautog landings have been <1% of the coastal harvest since 2007.
	2.1 C) VA will continue to supplement the Marine Recreational Fisheries Statistics Survey to obtain more detailed catch statistics at the state level. VA's new recreational saltwater fishing license may provide funding for more extensive surveys of the state's recreational fishery.	2009 2011 Continue 2011 Continue 2016 2017 2018 2019 2020	MD contracted to have supplemental MRFSS recreational data collected. MD implemented a coastal recreational saltwater license requirement. The MRFSS survey is being improved through implementation of the MRIP program. The NMFS requires all states to register recreational fishermen to create a more robust database to estimate recreational harvest. The MRIP estimated total observed and reported recreational harvest (A + B1) of tautog from Maryland during the 2016 fishing season was 882 fish. The MRIP estimated total recreational harvest (A + B1) of tautog from Maryland during the 2017 fishing season was 7,320 fish (PSE 68.7). The MRIP estimated total recreational harvest (A + B1) of tautog from Maryland during the 2018 fishing season was 19,779 fish (PSE 79.3). The MRIP estimated total recreational harvest (A + B1) of tautog from Maryland during the 2019 fishing season was 779 fish (PSE 68.9). The MRIP estimated total recreational harvest (A + B1) of tautog from Maryland during the 2020 fishing season was 44,088 fish (PSE 44.4).
	2.1 D) MD's Coastal Bays Fisheries Investigation will be expanded by conducting a creel survey from recreational headboats. The survey will collect biological data on tautog such as sex, length, age and information on recreational fishing effort.	1972 Continue 1999 2012	Juvenile tautog are sampled during the summer and fall coastal bays trawl and seine survey (not designed to target tautog). MD DNR annually collects age, length, weight, and sex data. Tautog are purchased from several commercial fishermen or collected by hook and line.

		2013-2020	MD Coastal Bays Fisheries Investigation annually collects age, length, and sex data for inclusion in the age length key and annual compliance report to ASMFC. Samples are collected at sea and at the dock in Ocean City.
2.2) The jurisdictions will promote research to determine the extent of migration and mortality in localized tautog populations. As reliance of this species on structure for both food and shelter may limit populations in the Chesapeake Bay area, studies designed to determine the relationship between population size and available shelter and food sources should likewise be encouraged.	2.2) Research on migration of tautog between areas is encouraged. Tagging experiments to provide data on tautog migration may be funded from sales of saltwater fishing licenses. The Virginia Game Fish Tagging Program will be continued.	Continue 2007 Continue Continue	A study on the seasonal occurrence of tautog in the lower CB indicates that most fish tagged and released in inshore waters remain inshore for the winter, rather than move offshore (Arendt, Lucy and Munroe, 2001). VA initiated the Marine Sportfish Collection Project to collect sex, length, and age data. Freezers were set up for recreational anglers to donate whole fish or carcasses. VA initiated the Saltwater Fisherman's Journal, where anglers log their fishing experiences and anecdotal information.
3.1.1) Restoration of aquatic reefs could lead to increased habitat for tautog. Jurisdictions will continue to expand and improve their current oyster restoration programs, with periodic program evaluations to ensure maximum success.	3.1.1A) MD and VA will continue the implementation of the 1994 Oyster FMP, which combines the recommendations of both the Virginia Holton Plan and the Maryland Roundtable Action Plan. Strategies in both VA & MD have taken a new focus, as the programs intensify efforts to manage around the devastating oyster diseases, Dermo and MSX, currently infecting Chesapeake Bay oysters.	Continue 2004 2008 2009 - 2010 2012 Continue	The 1994 Oyster FMP was revised and adopted in 2004. It incorporated concepts from the 1994 FMP and the Aquatic Reef Habitat Plan. Sanctuary and special management areas are protected from harvest and oyster habitat is being restored. A new oyster plan was developed in the spring of 2019. *Crassostrea virginica* (native oyster) and not *Crassostrea ariakensis* (Asian oyster) will be used for reef development following the Environmental Impact. Statement for Oyster Restoration in Chesapeake Bay Including the Use of a Native and/or Nonnative Oyster. MD DNR has expanded the oyster sanctuary network from 9% to 25% (app. 9,000 acres) of the available oyster habitat. Both recreational and commercial fish species will benefit from improved/protected oyster bar habitat. The number of oyster aquaculture permits and the number of acres of active aquaculture has been increasing since 2011.
	3.1.1B) MD and VA will continue the implementation of the Aquatic Reef Habitat Plan. "The purpose of the Aquatic Reef Habitat Plan is to guide the development and implementation of a	2007 Continue	Maryland's Artificial Reef Management Plan was developed, and several reefs have been built in the Bay.

	regional program to rebuild and restore reefs as habitat for oysters, and other ecologically valuable aquatic species."	Continue 2010 Continue	Reefs are qualitatively monitored with underwater video. There is no set sampling schedule or protocol. ARC and MARI have begun support for shallow water (<20 ft.) reef projects.
3.1.2) The creation of new artificial reefs and the expansion and improvement of preexisting reefs will provide additional habitat for the tautog population.	3.1.2A) Jurisdictions will continue to maintain, expand, and improve their artificial reef programs. Since 1995, VA has developed 3 new reef sites within the Bay, and expanded several existing sites, deploying more than 6,000 designed structures (concrete tetrahedrons) and over 5,000 tons of concrete rubble. MD has designated 3 sites as oyster sanctuaries where harvest is not allowed: Plum Point, lower Severn River and Cambridge. MD will also be examining the efficacy of small hill sanctuaries at 3 sites: Tangier, Choptank and Strong Bay (Chester River).	1996-2006 2007 Continue Continue 2008 2011 Continue 2016	MD terminated its program in 1996. Artificial reef development was administered in the Chesapeake Bay by the MD Environmental Service, and in the Atlantic Ocean by the Ocean City Reef Foundation (OCRF). MD Artificial Reef Committee and the MD Artificial Reef Initiative (MARI) were established to develop reefs in cooperation with OCRF. Both the MARI and the OCRF accept private donations, while MD contributes funds when available for reef development projects. In VA, artificial reefs are being funded through the Recreational Advisory Board. All artificial reefs are created with funds from recreational license revenues that adhere to gear type prohibitions. 44 NY subway cars were deployed off Ocean City. USN Destroyer *Radford* was reefed on August 10, 2011. The vessel has since broken into 3 pieces, but remains upright. The MARI and OCRC continue to develop existing and new artificial reefs as funding and materials become available. For the most up-to-date information on the MD artificial reef program go to https://dnr.maryland.gov/fisheries/pages/reefs/index.aspx and for the VA artificial reef program go to https://mrc.virginia.gov/vswft/angler_guide/angler_web_reef.pdf The USACE permit for MD Chesapeake Bay reef sites expired in August 2015. A new permit was issued in June 2016, and is a 10-year "umbrella permit" that covers 21 sites in Chesapeake Bay, through the end of 2026.

			The MD reef program deployed 55 low profile reef balls at Memorial Stadium Reef, in May 2016. The reef balls were constructed by volunteer groups organized by a local Maryland Saltwater Sportfishing Association chapter. Three deployments were completed at the Love Point reef site. These deployments totaled 1,900 tons of secondary use concrete materials. Seventy "mini bay-ball" reef balls were deployed at the Tilghman Island reef site, in July 2016. The reef balls were constructed by volunteers from local Coastal Conservation Association (CCA) chapters and students at Carroll County Public Schools, and seeded with oyster spat. Six hundred tons of concrete rubble, donated by Dominion Resources, was deployed at the Cedar Point reef site near the mouth of the Patuxent River, in November 2016.
		2017	MD deployed recycled materials at Love Point, Plum Point, and Tangier Sound reef sites in the first quarter of 2017. MD anticipates a steady stream of concrete from the Baltimore region over the next year that should provide material for several sites. The VA artificial reef program completed 4 deployments to existing reef locations. Two deployments occurred on one of five offshore Virginia reefs managed by the program. Both were on the Triangle reef, located 25 miles off of Virginia Beach. In May, 90 tons of armored undersea cable were placed in the North West corner of the permitted reef area. In October, the Coast Guard deployed 5 concrete sinkers, each weighing approximately 12,000 lbs, stacked in a pyramid shape at the site. The Cabbage Patch reef located in the south eastern corner of the Chesapeake Bay received 2 deployments in 2016. The first was the initial load of Lesner bridge material (450 tons of concrete decking pieces) deployed in March. On February 2, 2017, the first full load of this material from the Lesner Bridge was deployed. The second deployment consisted of five concrete Coast Guard sinkers (12,000 lbs each) stacked in a pyramid shape deployed in September.
		2018	The OCFR sank a 60 foot barge at Capt. Bob Gowar's Memorial Reef in May and a 55 foot barge at Capt. Jack Kaeufer's Memorial Reef in late July. In December a 50

			foot barge was sunk at the Capt Greg Hall Memorial Reef. The MD Reef Program in Chesapeake Bay deployed 140 reef balls that were placed in an east-west line in the vicinity of Tilghman Island. These were estimated at 9 ton of material covering an estimated area of 4,200 ft^2. A 120ft steel deck barge was deployed in the vicinity of Tangier Sound, covering an estimated area of 3,600 ft^2. Love Point vicinity had seven deployments, totaling 6,200 tons of concrete, and covering an estimated area of 33,400 ft^2.
	3.1.2B) VA has recently prohibited the use of all gear except recreational rod and reel, hand-line, spear, or gig on four artificial reefs in state waters. The result of this regulation is similar to the MAFMC/ASMFC Special Management Zones that protect vital tautog habitat.	Continue	MD and VA both adopted legislation that prohibits hydraulic clamming (and crab dredging in VA) in or near SAV beds. MD has a prohibition on hydraulic dredging in the Coastal Bays. It is allowed in MD's Chesapeake Bay waters, but not within a delineated SAV bed. There is no required setback from the bed.
3.2.1) Jurisdictions will continue efforts to: "achieve a net gain in SAV distribution, abundance, and species diversity in the Chesapeake Bay and its tributaries, over current populations".	3.2.1.1A) Protect existing SAV beds from further losses due to increased degradation of water quality, physical damage to the plants, or disruption to the local sedimentary environment, as recommended by the Chesapeake Bay Submerged Aquatic Vegetation Policy Implementation Plan.	Continue	MD and VA prohibit hydraulic clamming and crab dredging (VA) in or near SAV beds. MD prohibits hydraulic dredging within delineated SAV beds, but there is no required setback.
	3.2.1.1B) The Guidance for Protecting Submerged Aquatic Vegetation in the Chesapeake Bay from Physical Disruption was developed in response to the above action, and should be used by agencies making decisions that influence SAV survival in the Chesapeake Bay. The following recommendations from the guidance document should be strongly considered when making decisions that impact SAV, with special emphasis on SAV that falls within the salinity range of juvenile. 1. Protect SAV and potential SAV habitat from physical disruption. Implement a tiered approach to SAV protection, giving highest priority to protecting Tier I and Tier II areas, but also protecting Tier III areas from physical disruption. 2. Avoid dredging, filling or construction activities that create turbidity sufficient to impact nearby SAV beds, during SAV growing season.	Continue Continue 2003 2008	MD implemented a living shorelines program in 1970 to encourage vegetative shoreline stabilization. Regulations are in place to prohibit dredging through SAV beds. Tiered designation and prioritization of SAV beds has not been implemented. Avoidance of dredging, filling and construction impacts to SAV is strictly enforced by the MDE and USACE with input from the DNR, USFWS, and NMFS. MD has not established undisturbed buffers. VA has established buffer criteria. The revised SAV goal adopted by the Chesapeake Bay Program was restoration of 185,000 acres of SAV by 2010, and planting 1,000 acres of SAV by 2008. MD legislated that shoreline stabilization projects must use living shoreline techniques, unless demonstrated to be infeasible.

	3. Establish an appropriate undisturbed buffer around SAV beds to minimize the direct and indirect impacts on SAV from activities that significantly increased turbidity.	2012 2014 Continue 2015 2016 2017	The SAV planting goal was revised to be the planting of 20 acres per year. A new Chesapeake Watershed Agreement was adopted in 2014. The Bay jurisdictions developed a SAV outcome (goal) and a management strategy as a framework for reaching the goal. Biennial work plans are currently under development, and will include actions to reach the baywide goal of 130,000 acres by 2025. Total area of SAVs in the Coastal Bays (2015) was 8,743 acres. Total area of SAVs in the Chesapeake Bay (2016) was 97,433 acres. In 2017, an estimated 104,843 acres of SAVs were mapped in the Chesapeake Bay. This total marks the highest amount recorded by VIMS researchers since the decades-long monitoring began, and total abundance has now surpassed 100,000 acres. Higher salinity accounted for a sustained recovery of eelgrass, while moderate salinity areas had an increase in widgeon grass. Because widgeon grass is a "boom and bust" species whose abundance can rise and fall from year to year, a widgeon-dominant spike is not guaranteed to persist in future seasons https://www.chesapeakebay.net/state/underwater_grasses
	3.2.1.2) Set and achieve regional water and habitat quality objectives that will result in restoration of SAVs through natural revegetation, as recommended by the Chesapeake Bay SAV Policy Implementation Plan.	Continue	Water quality criteria have been adopted, and there is a water quality outcome in the 2014 Chesapeake Watershed Agreement. http://www.chesapeakebay.net/restoringwaterquality.aspx?menuitem=14728
	3.2.1.3) Set regional SAV restoration goals in terms of acreage, abundance, and species diversity considering historical distribution records and estimates of potential habitat as recommended by the Chesapeake Bay SAV Policy Implementation Plan.	2003 Continue	Chesapeake Bay Program adopted a revised SAV goal to plant 1,000 acres of SAV by 2008; 173 acres have been planted to date. The SAV planting goal was revised in 2012 to the planting of 20 acres per year. One acre was planted during 2013. The restoration goal is 185,000 acres of SAVs by 2025 VIMS annually surveys SAV distribution in the Chesapeake Bay. 2013 SAV acreage was 59,711: 2014

			estimated acreage was 75,835; 2015 was 92,315 acres, and 2016 estimate was 99,619 acres. Estimated acreage for 2017 was 104,843. https://www.chesapeakeprogress.com/abundant-life/sav https://www.chesapeakebay.net/files/2020-2021_sav_logic_and_action_plan.pdf
3.2.2) The jurisdictions will use The Submerged Aquatic Vegetation Habitat Requirements and Restoration Targets: A Technical Synthesis as a guide to set quantitative levels of relevant water quality parameters necessary to support continued survival, propagation and restoration of SAV, as well as established the regional SAV restoration target goals, defined earlier in this section.	3.2.2) When choices must be made in selecting SAV restoration projects, to fund and support under the Chesapeake Bay SAV Policy Implementation Plan, specific attention should be given to action items that lead to the protection and restoration of SAV found within the juvenile tautog habitat range.	Continue	More emphasis is being placed on multispecies benefits when considering restoration projects. Long-term survival of SAV plantings has been limited. STAC reviewed the SAV restoration projects, and concluded they were operationally successful, but functionally unsuccessful. SAV aerial surveys continue.
3.3) In 1998, the Chesapeake Executive Council adopted the Chesapeake Bay Wetlands Policy in recognition of the ecological and economic importance that wetlands play in the Chesapeake Bay. The Wetlands Policy establishes an immediate goal of no net loss, with a long-term goal of a net resource gain for tidal and nontidal wetlands. It identifies specific actions necessary to achieve both the short-term goal of the Policy, "no net loss," and the long-term goal of "a net resource gain for tidal and nontidal wetlands."	3.3) The jurisdictions should strive towards achieving the following, especially in the salinity range of tautog. a) define the resource through inventory and mapping activities b) protect existing wetlands c) rehabilitate, restore and create wetlands d) improve education e) further research	1991 Continue 2006 Continue 2009 Continue 2011 Continue 2014 Continue	Wonders of Wetlands (WOW) curriculum was developed. GIS mapping activities are underway to target protection and restoration of habitat resources. Habitats are not targeted to benefit a specific species. MD has developed a Blue Infrastructure that includes mapping structural habitat and SAV. Wetland mosquito ditches from the 1930s-1940s are being modified to reduce tidal flow, and restore wetland hydrology and function. Between 2010 and 2011, 3,775 acres of wetlands were established or reestablished, and 107,239 acres were enhanced or rehabilitated. The new Chesapeake Bay Program Watershed Agreement has a wetlands outcome to create or reestablish 85,000 acres of wetlands, and enhance the function of wetlands on an additional 150,000 acres.
3.4.1) Jurisdictions will continue efforts to improve Baywide water quality, through the efforts of programs established under the 1987 Chesapeake Bay Agreement. In addition, the jurisdictions will implement new strategies,	3.4.1A) Based on the 1992 baywide nutrient reduction plan reevaluation, the jurisdictions will: a) expand program efforts to include the tributaries b) intensify efforts to control nonpoint sources of pollution from agriculture and developed areas	Continue 2009	Maps that indicate regions of concern for living resources have been developed. See the Chesapeake Bay Program website for updates on nutrient reduction.

based on recent program reevaluations, to strengthen deficient areas.	c) improve on current point and nonpoint source control technologies		https://www.chesapeakebay.net/issues/threats-to-the-bay/nutrient-runoff
		2009	President Barack Obama's executive order recommitted federal agencies to Bay restoration and regulatory enforcement.
		2010	The EPA established a Bay wide TMDL (aka: pollution diet). Each jurisdiction must establish 2-year milestones for progress towards meeting its TMDL.
		2012	Legislation has been passed for restrictions on new developments using septic systems.
		2013	Legislation for a stormwater fee based on impervious surface coverage was enacted.
		2014 Continue	The 2014 Chesapeake Watershed Agreement outcome is to achieve a 60% reduction of nutrient and sediment pollution.
	3.4.1B) Based on the 1994 Chesapeake Bay Program Toxics Reduction Strategy Reevaluation Report, the jurisdictions will emphasize the following 4 areas: a) pollution prevention: target "regions of concern" & "areas of emphasis" b) regulatory program implementation: insure that revised strategies are consistent with and supplement, pre-existing regulatory mandates c) regional focus: identify and classify regions according to the level of contaminants d) directed toxics assessment: identify areas of low-level contamination, improve tracking and control nonpoint sources.	Continue	See Chesapeake Bay Program website for updates on nutrient reduction. https://www.chesapeakebay.net/issues/threats-to-the-bay/chemical-contaminants
			Chesapeake Bay Program is monitoring levels of mercury, PCBs, PAHs, organophosphate and organochloride pesticides.
		2014 Continue	There are two outcomes for toxic contaminants in the 2014 Chesapeake Watershed Agreement: develop a research agenda and best management practices pertaining to toxics and develop a policy to reduce and prevent toxic contaminants.
	3.4.1C) The jurisdictions will continue to develop, implement, and monitor their tributary strategies designed to improve bay water quality.	Continue 2003	Ambient water quality criteria of DO, water clarity, and chlorophyll-a have been adopted for the Chesapeake Bay.
3.4.2 The Chesapeake Bay Program partners will "plan for and manage the adverse environmental effects of human population growth and land development in the Chesapeake Bay watershed." In 1996, the	3.4.2) Encourage efficient development patterns which reduce nutrient and sediment loads to the Chesapeake Bay, and promote responsible land management practices and decisions regarding	Continue	See Chesapeake Bay Program website for updates on land stewardship. https://www.chesapeakeprogress.com/conserved-lands https://www.chesapeakebay.net/issues/threats-to-the-bay/development

Chesapeake Bay Program accepted the Priorities for Action for Land, Growth and Stewardship in the Chesapeake Bay Region, as a framework to address land use and development pressures in the Chesapeake Bay. This approach recognizes that communities are the basic unit for addressing growth, land-use and long-term stewardship of the natural environment. These priorities are voluntary actions which are expected to be accomplished through a variety of public and private partners, including but not limited to, the Chesapeake Bay Program. Jurisdictions will forward the goals of the Priorities for Action, which encourage sustainable development patterns. Given the fact that tautog are particularly vulnerable to suspended solids which abrade epithelial tissues, and to decreasing SAV and shellfish beds which serve as habitat and feeding areas, the goals of the Priorities for Action which are germane to nutrient and sediment load reduction will be promoted.	present and future development by pursuing the following: 1) Revitalize existing communities. Revitalization efforts can assist existing communities and help reduce sprawl by encouraging the use of state-of-the-art storm water management and pollution prevention strategies. 2) Encourage efficient development patterns. Ecologically sound, efficient development patterns encourage higher population density; compact and contiguous development. Benefits to the Bay include reduced impervious surfaces, and the conservation of farms, forests, and wetlands. 3) Foster resource protection and land stewardship. Cooperation and linkages among local watershed protection planning efforts should be increased to foster a regional sense of stewardship toward the bay's natural resources. The development of new policies that integrate natural and community infrastructure in public and private planning; development and protection efforts will further this goal.		MD developed a curriculum titled, "Where Do We Grow from Here?," about population growth and its impacts on the Bay. The 2014 Chesapeake Watershed Agreement includes outcomes for stewardship, environmental literacy and land conservation.

Acronyms

ARC – Artificial Reef Committee
ASMFC – Atlantic States Marine Fisheries Commission
CB – Chesapeake Bay
CCA MD – Coastal Conservation Association of Maryland
CPUE – Catch per Unit Effort
DO – Dissolved Oxygen
EEZ – Exclusive Economic Zone
EPA – Environmental Protection Agency
F – Fishing Mortality
FMP – Fishery Management Plan
GIS – Geographic Information System
MAFMC – Mid-Atlantic Fishery Management Council
MARI – Maryland Artificial Reef Initiative
MD DNR – Maryland Department of Natural Resources
MRFSS – Marine Recreational Fisheries Statistics Survey
MRIP – Marine Recreational Information Program
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
NY – New York
OCRF – Ocean City Reef Foundation
PAH – Polycyclic Aromatic Hydrocarbon
PCB – Polychlorinated Biphenyl
PRFC – Potomac River Fishery Commission
PSE – Percent Standard Error
SAV – Submerged Aquatic Vegetation
TMDL – Total Maximum Daily Load
USACE – United States Army Corps of Engineer
USFWS – United States Fish and Wildlife Service
USN – United States Navy
VIMS – Virginia Institute of Marine Science

2021 Maryland FMP Report (December 2022)
Section 20. a) Weakfish (*Cynoscion regalis*); b) Spotted Seatrout (C. nebulosus)

The last stock assessment update, and a study in North Carolina, concluded the weakfish stock is at historically low levels, due primarily to continued high annual natural mortality. The study in North Carolina concluded the majority of the high natural mortality occurs during the overwintering period, and the majority of the coastwide weakfish stock is believed to over winter in North Carolina. Until the trend of increased natural mortality abates, weakfish availability in Chesapeake Bay will remain low. Both of the Maryland juvenile indices were near their time series means, indicating a potential improvement in recruitment.

Fishery Management Plans (FMPs)

The Chesapeake Bay Weakfish and Spotted Seatrout Fishery Management Plan (CBW/SS FMP) was adopted in 1990 to enhance and perpetuate the Chesapeake Bay's weakfish and spotted seatrout stocks. Since then, the plan was revised in 2003 and addresses only weakfish and not spotted seatrout (see spotted seatrout 'notes' at the end of the weakfish update). The revised plan was developed in response to the improvement in the status of the weakfish stock from overfished (below a threshold) to fully exploited (fished at MSY; at that time) and included new biological data pertinent to the Chesapeake Bay. The 2003 CBW FMP follows the compliance requirements set forth in the ASMFC Amendment 4 to the Interstate Weakfish Management Plan (2002) and several addenda (2003 to 2009).

The CBP plan was reviewed by the Maryland Department of Natural Resources (MD DNR) Fishing and Boating Services (FABS) Plan Review Team (PRT) in 2012/2013. A report was presented to the Tidal Fisheries Advisory Commission and Sport Fisheries Advisory Commission as part of the plan review process. The PRT recommended no changes to spotted seatrout or weakfish allocation, but noted a need for additional socioeconomic data.

a) Weakfish

The ASMFC has been managing weakfish under an FMP since 1985. Additional management measures were adopted with Amendments 1-3 (1992, 1995, and 1996) and Addendum 1 (2000). With ASMFC Amendment 4 (2002) and subsequent addenda {I (2005), II & III (2007), IV (2009)}, targets and thresholds for fishing mortality rates (F) and spawning stock biomass (SSB) were developed. The biological reference points (BRPs) were updated and implemented in 2010. Management measures to protect weakfish and reduce bycatch are still in effect. Maryland is required to submit annual compliance reports to ASMFC for both weakfish and spotted seatrout.

Stock Status

A coastwide benchmark stock assessment was prepared in 2015, peer reviewed, and accepted for management by ASMFC in 2016. An updated Assessment, using the benchmark model with data through 2017, was completed in 2019. The updated model also uses the new MRIP recreational estimates, unlike the benchmark. Both the benchmark and its update indicate the Atlantic weakfish stock is depleted, and has been since 2003, but overfishing is not occurring. The term "depleted" is used when factors other than fishing mortality have contributed to a decline in biomass. The models use a bayesian statistical catch at age approach to examine time varying natural mortality, in addition to fishing mortality and recruitment. BRPs based on total mortality (Z) were adopted with the threshold set at 30%, and the target set at 20% of an unfished stock experiencing average fishing mortality. In the early 2000s, natural mortality increased significantly then stabilized at a high level, which led to an increase in Z. Fishing mortality (F) from 2011 to 2017 was low, but Z remained high. The Z from 2002 to 2017 was above the threshold, indicating total mortality was too high to allow for stock recovery. The SSB is well below the threshold and will require multiple years of reduced total mortality to recover. The dependent and independent monitoring of Maryland's fishery has shown both a decrease in mean adult age and low juvenile abundance. Despite current restrictive management measures, the depleted weakfish stock is unlikely to recover quickly without a decrease in natural mortality.[1,2] Prevailing theories for the increase in natural mortality are predation, competition, and changes in climate, but no definitive cause has been determined.

Current Management Measures

Management measures implemented by ASMFC's Addendum IV required states to implement a one fish per person per day recreational creel limit and a 100 lbs commercial trip bycatch limit. These management measures resulted in an estimated 60% reduction in commercial and recreational exploitation. Since 2010, the Chesapeake Bay jurisdictions have implemented restrictions to meet or exceed the ASMFC requirements on harvest and bycatch. In Maryland, the recreational creel limit and commercial bycatch limits continued through 2021.

The MD DNR conducts fishery dependent and fishery independent monitoring for important recreational and commercial fish species. Adult weakfish are sampled from pound nets. Maryland is required to provide biological data to ASMFC from the commercial catch, based on metric tons of commercial landings. Based on preliminary landings, Maryland was required to provide four lengths and two age

samples for 2021, and met the requirement. Juvenile fish are sampled from Maryland's Chesapeake Bay and Coastal Bays. Juvenile weakfish mean catch per unit of effort was higher in the 1990s, and reached lows in 2012 and 2019, respectively. Both indices have been variable since 2012, but have remained below their respective long term means. The Chesapeake Bay and Coastal Bays juvenile indices both decreased in 2021 after being close to their long term means in 2020.

Fisheries

Both estimated recreational harvest and commercial landings of weakfish decreased in the early 2000s to very low values (Figures 1 & 2). Harvest estimates and landings values have remained at historically low levels. The recreational harvest estimates in 2021 were 1,116 fish in Maryland and 7,196 fish in Virginia.[4] Many of the recent yearly values for both states have had high proportional standard errors, indicating these estimates are imprecise. The declining commercial landings trend began in 1999. Maryland and Virginia's 2021 commercial landings were 897 and 28,906 lbs, respectively.[5] Landings values for the past ten years are the lowest on record for both states for the entire NMFS time series (1950 to 2019).[5]

Issues/Concerns

Factors such as predation, competition, and environmental changes have increased natural mortality and appear to have a stronger influence on weakfish stock dynamics than harvest. Production of weakfish juveniles has not led to increased adult biomass.[1]

The ASMFC weakfish plan review team has reported its recommendations for management, biological research, social and economic research, and habitat studies.[3] Biological research recommendations were listed under high, medium, and low priorities. High priority recommendations include: Increase observer coverage to identify the magnitude of discards for all commercial gear types from both directed and non-directed fisheries; evaluate predation of weakfish with a more advanced multispecies model (e.g., the ASMFC MSVPA or Ecopath with Ecosim); consider an expanded suite of predators (e.g. marine mammals) and include weakfish as predator and prey; and develop a bioenergetics model that encompasses a broader range of ages than Hartman and Brandt (1995) and use it to evaluate diet and growth data.

Results of a weakfish tagging study in North Carolina were published in 2020. The researchers used both the tagging study data and age data from an independent gillnet survey to construct a model to estimate total mortality, fishing mortality, and natural mortality in North Carolina by season (North Carolina is believed to be the primary overwintering area for weakfish). The study concluded that total mortality was similar to that derived by the last benchmark assessment, but natural mortality was likely a higher component of total mortality than estimated in the benchmark assessment, which, as discussed above, is already considered the driving factor for the current depleted status. They also concluded that the winter period, and the migration periods to and from the wintering area, account for the majority of the natural mortality, and that natural mortality is low when weakfish are within North Carolina estuaries.[6]

Figure 1. Maryland and Virginia estimated recreational weakfish harvest in numbers from the NMFS MRIP online database, 1981-2021.[4]

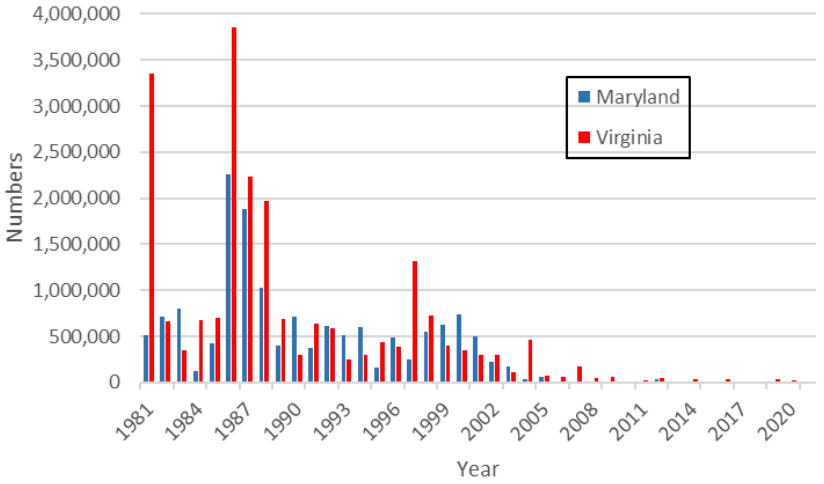
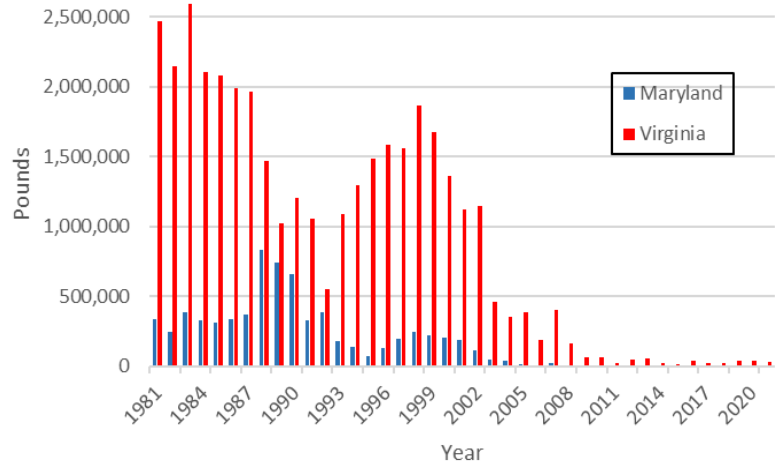


Figure 2. Maryland and Virginia commercial weakfish landings, 1981-2021.[5] All data from the NMFS online database.



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[2] Atlantic States Marine Fisheries Commission. 2019. Weakfish Stock Assessment update Report, Arlington, VA 86p. https://asmfc.org/wp-content/uploads/2025/01/Oct_2019WeakfishAssessmentUpdate.pdf

[3] Atlantic States Marine Fisheries Commission. 2021. Review of the Interstate Fishery Management Plan for Weakfish (*Cynoscion regalis*), 2019 Fishing Year. Arlington, VA 23p. https://asmfc.org/wp-content/uploads/2025/01/2020_Weakfish_FMP_Review_FINAL.pdf

[4] Personal communication from the National Marine Fisheries Service, Marine Recreational Information Program, Fisheries Statistics Division September 16, 2022.

[5] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division September 16, 2022.

[6] Krausea, J.R., J.E. Hightower, S.J. Poland, J.A. Buckel. 2020. An integrated tagging and catch-curve model reveals high and seasonally varying natural mortality for a fish population at low stock biomass. Fisheries Research 232.

2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation			
Strategy/ Problem	**Action**	**Date**	**Comments**
Stock Status Management Strategy: CBP jurisdictions will adopt biological reference points (BRPs) that reflect the most current status of the weakfish stock. As data becomes available on multi-species interactions and ecological considerations, such as species interactions, food webs, bycatch, biodiversity and habitat, the BRPs should be modified accordingly.	1.1 MD, Potomac River Fisheries Commission (PRFC) and VA will adopt the Atlantic States Marine Fisheries Commission's (ASMFC) recommendations for the coastwide management of weakfish	2003 Annually reviewed and adjusted if necessary	The ASMFC conducted a peer reviewed stock assessment in 2015, and an update of that assessment was conducted in 2019. Both assessments indicated the stock is depleted, and has been since 2002. The biomass decline is the result of increasing natural mortality while F remains low. Size and age structure of the stock has decreased. New total mortality-based BRPs were approved (May 2016). Total mortality was above the threshold in 2017 (the terminal year of the model update), and has been since 2002. Stock biomass is still very low, and will require several years of low total mortality to recover.
	1.2 In order to achieve the fishing target rates defined by the adopted BRPs, CBP jurisdictions will utilize a combination of size limits and possession limits, and/or seasons or areas to manage the commercial and recreational fishery in state waters.	2003 Annually	ASMFC Addendum IV (2009) to Amendment 4 of the weakfish FMP requires that the recreational creel does not exceed 1 fish/person/day in the CBP jurisdictions. Commercial landings must be limited to 100 lbs./vessel/day or trip, whichever is the longer time period for directed fisheries, and bycatch must be limited to 100 lbs./vessel/day or trip for all non-directed fisheries. The finfish trawl fishery allowance for undersized fish must be reduced to 100 fish. The requirements have remained in effect since 2010. The CBP jurisdictions are in compliance; all met the recreational harvest restrictions, and met or exceeded the commercial harvest restrictions.
The Fishery Management Strategy: The CBP jurisdictions will regulate the commercial and recreational fishery based on the most recent status of the stock, and the established fishing targets.	2.1 The CBP jurisdictions will consider regional differences when determining state allocation issues and regulations.	2003 As necessary	The Maryland SFAC recommended a weakfish moratorium but no action was taken. Fishing mortality has been decreasing over the years but there remains a significant amount of non-fishing mortality.
	2.2 The CBP jurisdictions will consider the economic impacts of management measures on the fishery, and promote the utilization of economic data in the management decision process.	2003 Dependent on the availability of economic data	Collection of economic data for the commercial fishery should include dockside values, the number of commercial vessels, the number of commercial fishermen, and the economic returns from the commercial fishery. Data collection for the recreational fishery should include the number of anglers, the number of directed trips, and angler expenditures. Detailed data collection will enable the development of bio-economic models that can estimate costs or benefits to consumers resulting from fishery regulations.
	2.3 The CBP jurisdictions continue to support the use of BRDs in non-directed fisheries and the appropriate mesh sizes in directed fisheries, to reduce the fishing mortality on small weakfish.	2007 Annually	ASMFC Addendum III (2007) to Amendment 4 of the weakfish FMP aligns BRD certification requirements between state and federal waters along with the SAFMC shrimp bycatch reduction device requirements.
The Fishery Research and Monitoring: The CBP jurisdictions will continue to monitor the biological	3.1 The CBP jurisdictions will continue fishery dependent sampling and improve catch data. Economic information from the recreational and	2005 Continue	Monitoring data provides information on abundance, age structure, and growth parameters. The ASMFC Addendum I to Amendment 4 stipulates that states must collect otoliths and fish lengths based on each states' landings to provide data for coast wide stock assessments. In 2021, otoliths were removed from 10 weakfish during the MD pound net sampling in the Chesapeake Bay. Ages one

characteristics of the weakfish stock in the Chesapeake Bay, and coordinate monitoring activities within the Bay and the Atlantic coast.	commercial fisheries will also be reviewed.		through four were present, and 2021 was the first year age four fish were encountered since 2007.
	3.2 The CBP jurisdictions will conduct fishery independent sampling and collect data on abundance, age structure and recruitment.	Continue	Weakfish juvenile abundance from the Maryland Blue Crab Trawl Survey in Pocomoke and Tangier sounds generally increased from 1989 to 1996, remained at relatively high levels through 2001, then generally decreased from 2003 to 2008, and has remained moderate to low. The Chesapeake Bay juvenile geometric mean in 2019 and 2020 approached the 33-year time series mean, but declined in 2021. A second JI index is generated from the Coastal Bay Trawl survey. The geometric mean from this survey decreased to the lowest value of the 32-year time series in 2019, increased to near the time series mean in 2020. but declined again in 2021.
	3.3 CBP jurisdictions will continue to coordinate state activities with the Atlantic Coast Cooperative Statistics Program (ACCSP).	Continue	The ACCSP Coordinating Council approved the Atlantic States Fisheries Data Collection Standards document in May, 2012. This document is used to direct partner data collection.
	3.4 The CBP jurisdictions will begin to collect and examine stomach contents data and the effects of environmental variables upon weakfish growth rates.	Continue	Data from the ChesMMAP Survey (2002 – present), CHESFIMS (2001-2006) projects may be used to evaluate species interactions and relationships. Results and trends can then be incorporated into CBP fishery management plans.
Habitat Management Strategy: CBP jurisdictions will monitor and regulate activities which may be harmful to weakfish habitat.	Activities which contribute to the degradation and or loss of habitat types that weakfish utilize throughout their life history stages will be monitored and regulated by CBP jurisdictions.	2000 2014 Continue	CBP jurisdictions support the commitments of the Chesapeake Bay 2000 Agreement. These activities include reducing the discharge of toxic pollutants or excessive nutrients into the Chesapeake Bay and its tributaries, interruption or changes in water discharge patterns, deposition of solid waste, sewage sludge or industrial waste into Bay (which may lead to anoxic conditions), rapid coastal development, unregulated agricultural practices, net coastal wetland loss, or the dredging of contaminated sub-aqueous soils. The CBP developed a Watershed Agreement (2014) with habitat outcomes. For more information see: https://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf
	4.1 The CBP jurisdictions will monitor and regulate land-based activities and water-based activities that may negatively impact Chesapeake Bay water quality and weakfish spawning, rearing and foraging areas.	Continue	The MD DNR water quality protection database focuses on watershed lands that are most important for improving water quality.
	4.2 The CBP jurisdictions will monitor important weakfish forage species to insure that activities, such as directed fisheries or incidental bycatch in non-directed fisheries, do not adversely	Continue	Data from the ChesMMAP, CHESFIMS (2001-2006), and the MD Winter Trawl Survey provide data on important forage species for weakfish. The CHESFIMS survey was discontinued after 2005 and a modified year in 2006 due to lack of funding.

	affect abundance. These managed species, which serve as forage for weakfish include Atlantic croaker, spot, Atlantic menhaden, and blue crab. If fishing activities are contributing to higher F's on forage species, additional management measures may be necessary.	2014 Continue	The CBP developed a Watershed Agreement (2104) with new forage species outcome. For more information see: https://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf
	4.3 The CBP jurisdictions will monitor the abundance of weakfish forage species that are not managed under CBP FMPs, such as bay anchovies, and Atlantic silversides, using on-going monitoring and surveys.	Continue	The MD Estuarine Juvenile Finfish Survey and VIMS Juvenile Abundance Monitoring Surveys (formerly known as the VIMS Trawl Survey and the VIMS Juvenile Seine Survey) will continue to monitor the abundance of important, non-managed forage species in the Chesapeake Bay.
	4.4 The CBP jurisdictions will continue to identify predator/prey interactions, both inter- and intraspecies competition and other interactions that might affect the management of weakfish. As multispecies interactions are evaluated and quantified, biological reference points and management strategies may be adjusted.	Continue 2014 Continue	Data from the ChesMMAP, CHESFIMS (2001-2006), and the MD Winter Trawl Survey is collected and analyzed by CBP jurisdictions to identify possible inter-and intra-species relationships. The CB Watershed Agreement (2014) has a forage species outcome that will evaluate predator/prey interactions. A forage management strategy was developed in 2014/2015 and a biennial work plan was developed for 2016/2017 and updated for 2018/2019. The work plan includes actions to identify important forage species, evaluate a process for developing indicators and develop a process to manage for key predators.

b) Spotted Seatrout Notes:

Current stock status is unknown, as there is no coast-wide assessment, since most of the stock is non-migratory. An assessment in Virginia in 2014 suggested overfishing was not occurring and the stock was not overfished in Virginia waters. Landing and survey values since 2014 do not suggest a significant change in stock status in Virginia since 2014. Within the Chesapeake Bay region, Virginia accounts for the majority of harvest. Spotted seatrout in the Chesapeake Bay region have been primarily targeted by sport anglers in recent years, based on the relatively modest commercial harvest, compared to recreational harvest and high recreational release estimates.

The Atlantic States Marine Fisheries Commission (ASMFC) adopted the Fishery Management Plan (FMP) for Spotted Seatrout in 1984 for states from Maryland to Florida and Amendment 1 in 1991. An Omnibus Amendment (2011) was developed to bring spot, spotted seatrout, and spanish mackerel under the authority of the Atlantic Coastal Fisheries Cooperative Management Act (1993) and the ASMFC charter (1995), and was approved with corrected language in February 2012.[1] The omnibus amendment includes recommended measures to protect the spotted seatrout spawning stock by restricting catch to mature fish and requires a coastal minimum length limit.

Spotted seatrout were included in the 1990 Bay Program Chesapeake Bay *Weakfish and Spotted Seatrout Fishery Management Plan*. The management plan was revised in 2003 to include only weakfish. Since 1990, there has been no new management plan for spotted seatrout but updates have been completed on a regular basis. The 1990 FMP was reviewed by the MD DNR FABS PRT in 2012/2013. A report was presented to the Sport Fisheries and Tidal Fisheries Advisory Commissions. The Tidal Fisheries Advisory Commission recommended no action but the Sport Fisheries Advisory Commission recommended that the Maryland DNR FABS consider raising the minimum size limit and decreasing the creel limit. Maryland

increased the commercial size limits, decreased the recreational creel limit and instituted a daily commercial catch limit in 2013.

Stock Status

A coastwide stock assessment of spotted seatrout has not been completed because this species is considered to be largely non-migratory. State assessments have been completed on local stocks (VA, NC, SC, GA, FL) with state-by-state variability and no regional trend. A peer-reviewed stock assessment was completed for Virginia in 2014. Based on the results, it appeared that the stock was not overfished and overfishing was not occurring. ASMFC has not recommended a coastal stock assessment because spotted seatrout are basically a non-migratory species in their southern range, and there is very little data available on migration where it occurs. The lack of a stock assessment makes it difficult to implement an effective management framework. Some states are collecting biological and fisheries data in an effort to improve the quantity and quality of data which should lead to a better assessment of the stock.

MD DNR samples commercial pound nets weekly from late May through mid September. Seven spotted seatrout were encountered in 2021, a decline from 2020, which was the highest number encountered in the survey. A few juvenile spotted seatrout are caught in the Coastal Bays seine survey and the Maryland blue crab summer trawl survey in most years. In 2021, three juveniles were caught by seine and seven were caught in the Chesapeake trawl survey.

Management Objectives and Measures

The ASFMC FMP requires a size limit of 12" minimum total length. All states have complied with this minimum. Net mesh sizes corresponding to this size limit for directed fisheries, data collection, and state stock assessments were also recommended. Maryland, Virginia and PRFC have 14" recreational size limits with a 4 fish creel limit in Maryland, a 5 fish creel limit in Virginia, and a 10 fish creel limit for the Potomac mainstem (PRFC). In Virginia there is a limit of only 1 fish over 24 inches. The Maryland commercial size limit is 14" with minimum 3-3/8 inches trawl and 3 inch stretched gill net meshes (the same mesh size restrictions apply to weakfish) and a 150 pound per trip harvest limit for all gear. The Virginia commercial hook & line fishery must adhere to the same size and bag limits as the Virginia recreational fishery. Virginia also has an annual commercial quota of 51,104 lbs. and a size limit of 14 inches for all gears combined. PRFC has a 14 inch commercial size limit.

The ASMFC considered withdrawing its FMP for spotted seatrout and relinquishing management to the individual states in 2015. The relatively non-migratory nature of spotted seatrout and inability to conduct a coastwide stock assessment limit the ability of the ASMFC to properly manage this species. Action was postponed indefinitely, due to some states linking their FMP's management authority to the ASMFC FMP. If the affected states rectify their management authority through their regulatory process, the transfer of management authority from ASMFC to the states will be reconsidered.

Fisheries

The Marine Recreational Information Program (MRIP) estimated that Maryland annual recreational harvest has ranged from zero to 36,314 fish the past 15 years, with an average of 13,052 fish per year. The 2021 harvest estimate of 17,664 fish was above the 15 year mean, but still below the 1986-2005 mean of 41,945 fish per year (Figure 3). Most estimates have a high proportional standard error (PSE) values which indicate the estimates are highly uncertain in those years.

Catch-and-release estimates in the past 15 years have ranged from zero to 334,805 fish per year, but have been highly variable with no trend and very high PSE values. The Virginia recreational harvest estimates have been consistently higher than Maryland's harvest with lower PSE values and ranged from 23,062 to 644,074 fish per year from 2006 to 2021. The 2021 estimated harvest for Virginia of 399,529 fish was lower than the 2019 and 2020 values, but was still above the time series mean. Release estimates for Virginia the past 15 years have ranged from 549,846 to 4,455,420 fish per year, with a 2021 value of 3,035,971 fish, and a 15 year mean of 2,136,074 fish.

Maryland commercial landings since 1982 have been less than 2,500 lbs. most years, except for a peak in landings from 1996 to 2002 when landings averaged 20,515 lbs. per year (Figure 4). Virginia's commercial landings have averaged 29,750 lbs. per year since 1982 but experienced unusually large peaks in 2012 and 2019, with 116,768 and 135,729 lbs reported respectively.

Issues and Concerns

Spotted seatrout are generally found within their natal estuary. The species is comprised of unique spatial populations and very little mixing occurs outside of adjacent estuaries.[4] There are distinct genetic differences among populations along the Atlantic coast that supports the idea of limited mixing of subpopulations. Seasonal movements out of the Chesapeake Bay are currently the only example of notable spotted seatrout migration.

Spotted seatrout larvae and juveniles prefer seagrass habitats but will also utilize shallow marsh habitats. These areas need protection as important fish habitat.

Juvenile spotted seatrout are prey for larger fish including striped bass. Spotted seatrout are vulnerable to winter kill during unusually cold winters. A study in North Carolina confirmed that natural mortality in winter was often the highest source of mortality throughout the year, and varied with winter severity.[5]

Figure 3. Estimated recreational harvest for spotted seatrout from Maryland and Virginia, 1986-2020.[2] (NMFS MRIP data)

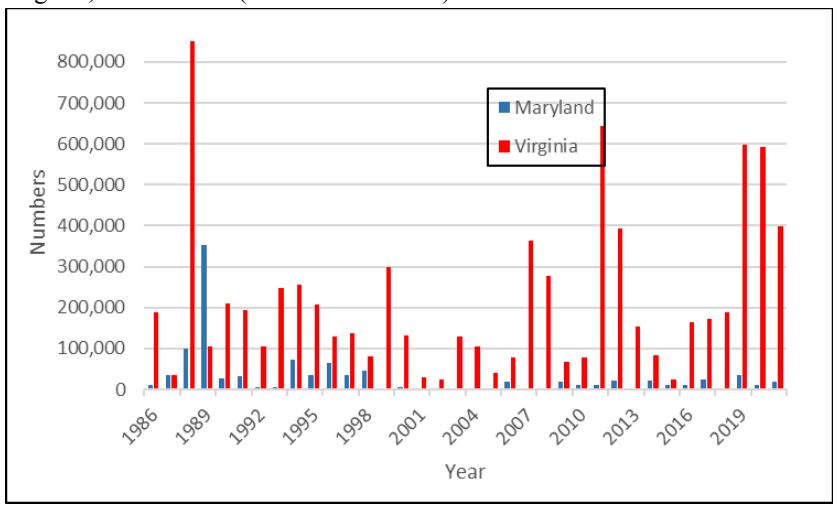
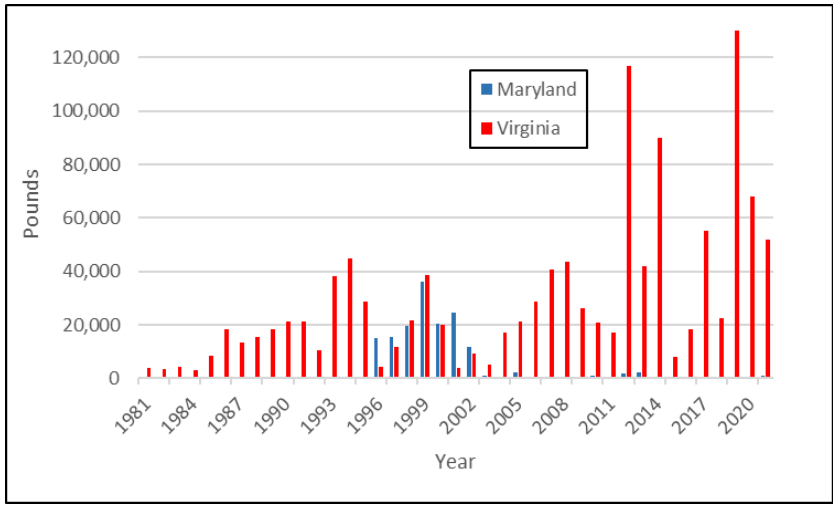


Figure 4. Commercial spotted seatrout landings from Maryland and Virginia, 1982-2020[3] (NMFS data for all of Virginia and through 2006 for Maryland, and Maryland state commercial landings database for 2007-2020)



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Acronyms

ACCSP – Atlantic Coast Cooperative Statistics Program
ASMFC – Atlantic States Marine Fisheries Commission
BRD – bycatch reduction device
BRPs – biological reference points
CHESFIMS – Chesapeake Bay Fishery Independent Multispecies Fisheries Survey
ChesMMAP – Chesapeake Bay Multispecies Monitoring and Assessment Program
CBP – Chesapeake Bay Program
F – Mortality due to fishing
FMP – Fishery Management Plan
PRFC – Potomac River Fisheries Commission
PSE – Proportional Standard Error
SAFMC – South Atlantic Fishery Management Council
SFAC – Sport Fisheries Advisory Commission
SSB – spawning stock biomass
TC – Technical Committee
VIMS – Virginia Institute of Marine Science
YOY – young of the year fish

2021 Maryland FMP Report (December 2022)
Section 21. White Perch (*Morone americana*)

In 2021, recreational anglers harvested more than 1.56 million lbs or 4.52 million white perch in Maryland.[1] White perch are one of the most sought after species by recreational anglers, second only to striped bass. In addition, white perch rank in the top five finfish species harvested by commercial fishermen.

Maryland Fishery Management Plan (FMP)

A Maryland Fishery Management Plan (FMP) for White Perch was drafted in 1990, but was never formally adopted by reference into Maryland regulations. The Maryland FMP continues to provide a framework for managing the white perch resource. The FMP includes descriptions of the life history, fisheries, economic perspective, resource status, habitat issues, management unit, status of traditional fishery management approaches, and data needs. The management framework includes goals and objectives, problem areas, and management strategies. The 1990 plan was reviewed in 2005 and again in 2015. No changes were recommended for the management of white perch in Maryland at this time.

Stock Status

The 2009 Maryland stock assessment noted that biomass was above minimum stock levels, and estimated fishing mortality (F) was lower than necessary to maintain stock abundance. The assessment cautiously noted that some indices of commercial catch-per-unit-effort (CPUE) were trending lower, while recreational CPUE trended higher. The 2009 stock assessment used a surplus production model for the Maryland portion of the Chesapeake Bay and a Catch Survey Analysis (CSA) in the Choptank River.[2] The 2011 white perch stock assessment used a different modeling approach to better describe the white perch populations regionally. The CSA model results described population dynamics in the Upper Bay and Choptank River from 2000 to 2010. The most recent stock assessment (2015) used the same methodology as 2011, but included the three years of additional data (2012 to 2014). Models indicated that populations in the Upper Bay were at near time series highs and F was low. In the Choptank River, populations were at average levels, and F was close to fully exploited levels.

Age 1 white perch relative abundance in the Upper Bay trawl survey was near average in 2013, below average in 2014, and decidedly above average in 2015 and 2016. In 2017, age 1 white perch relative abundance in the winter trawl survey was well below average. Relative abundance of age 1 white perch was slightly above average in 2018. In 2019, age 1 white perch relative abundance was less than 2018, but still above average. In 2020 and 2021, the age 1 white perch relative abundance was below average (Figure 1). There is less available data to assess Lower Bay white perch populations. For those areas, both fishery-dependent and fishery-independent indices were examined.[2] Although biological reference points (BRPs) have not been formally established, a target (F_{target}) of 0.60 was suggested. Between 2000 and 2013, F has not exceeded the F_{target}.[3] Based on the proposed target F, overfishing is not occurring.

Both Maryland and Virginia calculate young of the year (YOY) indices for white perch. Results from recent years have shown intermittently strong year-class production. Very strong year-classes were produced in 2011, 2014, 2015, and 2018. Year-class production was below average in 2019, 2020, and 2021 (Figure 2). In addition to YOY surveys, an adult white perch index was calculated with data from the Potomac River Striped Bass Spawning Stock Survey.

Current Management Measures

White perch are managed in coordination with striped bass because they overlap in habitat. They are caught using some of the same commercial gear types, such as drift gill nets. In addition, fyke nets are used to harvest white perch. White perch are managed as a single stock throughout its range in Maryland's portion of the Chesapeake Bay. The commercial fishery is regulated with gear and area restrictions, and an 8 inches minimum size limit if caught by net. There is no size limit for fish caught by hook-and-line in the commercial and recreational fishery, and no closed season or creel limit in either white perch fishery. Virginia has no size, creel, or season limits for recreational or commercial fishing.

The Fisheries

Maryland commercial landings in 2013 were 1.24 million lbs, with an estimated value of $1.32 million. Maryland commercial landings for white perch were 1.5 million lbs in 2014, with an estimated value of $1.04 million and 787,643 lbs in 2015, with an estimated value of $1.0 million. The estimated commercial harvest in 2016 was 1.85 million lbs, with an estimated value of $1.4 million. In 2017, the commercial harvest decreased to an estimated 1.43 million lbs, with a value of $1.35 million. The commercial harvest in 2018 was 1.94 million lbs, with a value of $1.92 million. In 2019, the commercial harvest was 1.09 million lbs and valued at $901,839. In 2020, commercial harvest was 490,645 lbs. Commercial landings continued to decline in 2021 with landings totaling 286,997 lbs valued at $255,555 (Figure 3). The recreational harvest of 305,182 lbs in 2015 was below the long-term average of 587,130 lbs (1981 to 2015) (Figure 4). The 2016 recreational harvest of 868,954 lbs was well above the long-term average, and the 2017 recreational harvest was nearly double that of 2016 at 1.65 million lbs. The recreational harvests in 2018

and 2019 were estimated at 904,408 lbs and 2.02 million lbs, respectively. In 2020, the recreational harvest was estimated at 2.52 million lbs. Recreational harvest for 2021 was estimated to be 1,561,573 lbs (Figure 4).

Issues/Concerns

Until 2020, white perch harvests had recently rebounded from a period of lower reports in the mid-2000's (Figure 3). The lower harvest in 2020 could be attributed to the amount of effort by commercial fishermen during the COVID 19 stay at home order which was in place at the peak of the spawning run when white perch are more readily accessible. Fishing mortality has been low except for the most recent years, and the species is considered relatively resilient. The juvenile index is variable. High young-of-year CPUE values were found in 2001, 2003, and 2004, and were followed by high gill net catches in 2004 to 2006. Fishery independent sampling after 2007 produced inconclusive results.[2] The Fishing and Boating Services (formerly Fisheries Service) FMP plan review team stated that water quality and habitat were issues of concern for white perch.

Figure 1. Age 1 white perch relative abundance from upper Chesapeake Bay winter trawl survey. Not sampled in 2004, small sample sizes 2003 and 2005. Error bars=95% CI.

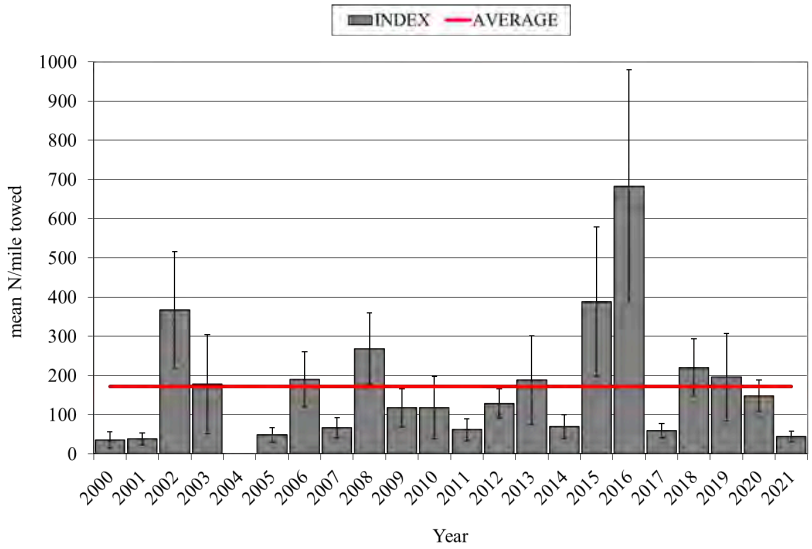


Figure 2. Maryland young-of-year geometric mean catch per haul for white perch, 1962 – 2021. Horizontal line= time series average. (EJFS data)

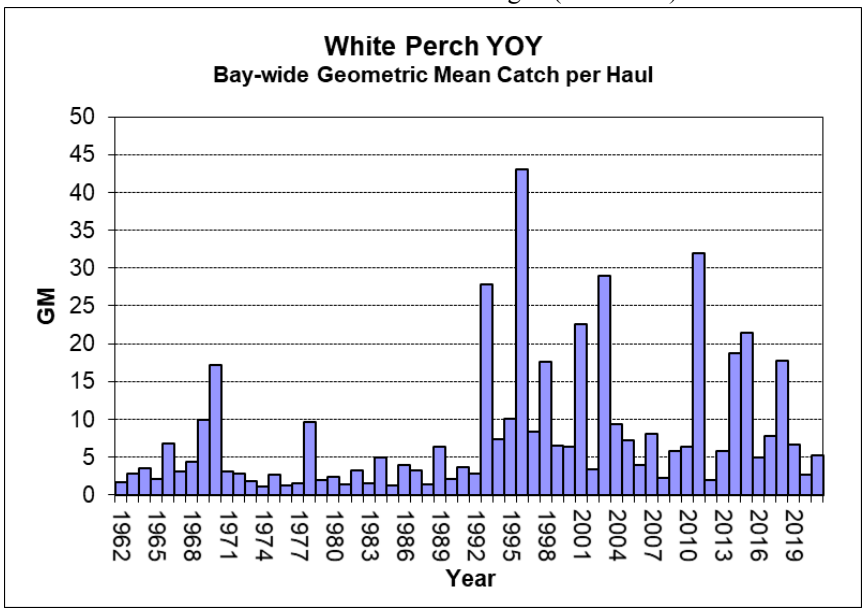


Figure 3. Commercial landings of white perch from Maryland, 1981-2021.

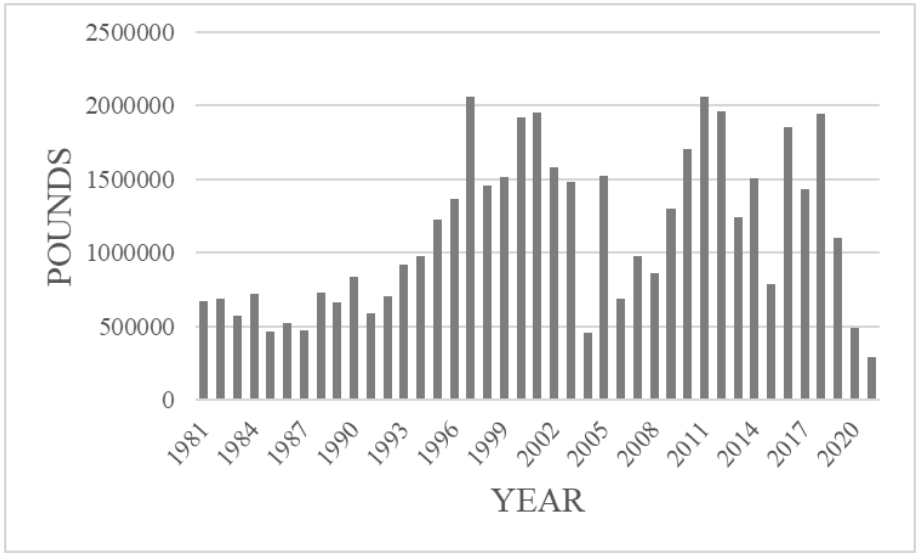
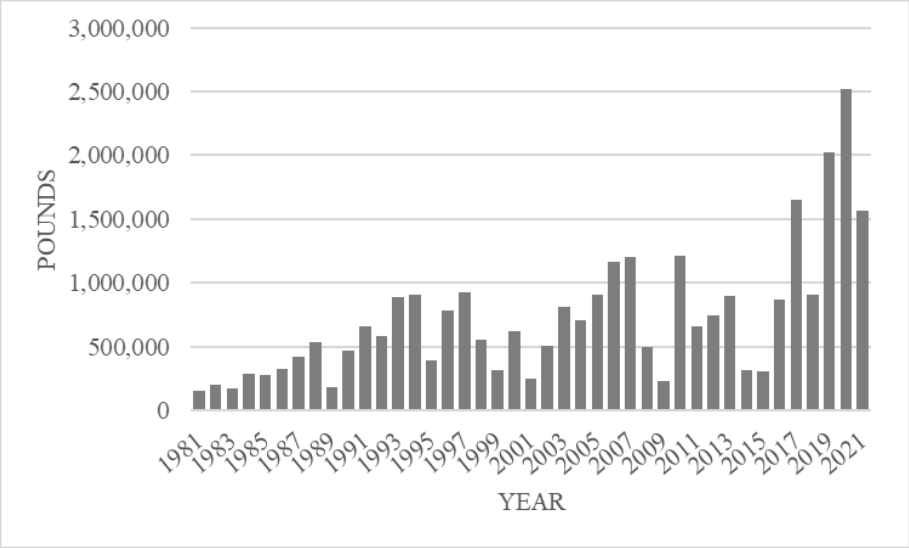


Figure 4. Estimated recreational white perch harvest from Maryland, 1981-2021.[1]



Acronyms

BRPs – Biological Reference Points
CSA – Catch Survey Analysis
CPUE – Catch per Unit Effort
EJFS – Estuarine Juvenile Finfish Survey
F – Fishing Mortality
H & L – Hook and Line
MD DNR – Maryland Department of Natural Resources
YOY – Young of Yea

References

[1] Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, Commercial Fisheries. September 13, 2020.

[2] Piavis, P.G. and E. Webb III. 2015. Population assessment of white perch in Maryland with special emphasis on Choptank River stocks. Maryland Department of Natural Resources, Federal Aid Report F-61-R, Annapolis, Maryland.

[3] Piavis, P.G. and E. Webb III. 2021. Population vital rates of resident finfish in selected tidal areas of Maryland's Chesapeake Bay. Maryland Department of Natural Resources, Fisheries Service Report F-61-R-9. Annapolis, Maryland.

Draft 1990 White Perch Fishery Management Plan Implementation Table			
Problem Area	**Action**	**Date**	**Comments**
Mixed Fishery 1.1. Coordinate management with striped bass actions.	1.1. The white perch fishery will abide by striped bass restrictions. Striped bass bycatch will be minimized.	1990 Continue	Commercial gear restrictions and area restrictions and closures apply. White perch are primarily caught with gill nets and fyke nets, both of which have mesh size and location restrictions that in some cases, vary seasonally.
Optimum Harvest 2.1. White perch populations exhibit growth differences.	2.1. Consider eliminating minimum size limits.	1990 Continue	Minimum size limit for commercial and non-H&L recreational set at 8”; no size limit for recreational H&L.
Stock Assessment 3.1. Basic stock information is lacking, including commercial and recreational harvest size and age-composition.	3.1. Stock assessments will be performed periodically.	2009 Continue	White perch stock assessments are performed every three to four years. A stock assessment survey was conducted in 2011 and 2015 and employed a catch survey analysis. This type of analysis has been better than surplus production models for assessing stock size. Young-of-year surveys produced high CPUE values from 1994-2001 and 2003-2004. However, fishery independent indices often conflicted and differed between areas examined.
		2013	Fishing mortality rates have decreased since 1997. Since 2000, fishing mortality rates have been under F=0.60 and the population has increased. Total upper Bay population abundance has been variable from 11 million fish (2001) to 4.4 million (2007.) The 2013 total population estimate for the upper Bay was approximately 10 million fish. .
		2015	White perch stocks are not overfished and overfishing is not occurring, based on the suggested F_{target} = 0.60. However, formal BRPs have not been adopted.
Habitat Issues 4.1. Water quality impacts distribution and abundance of finfish species in Chesapeake Bay.	4.1. MD will develop objectives for finfish water quality standards under the latest Bay agreements, including nutrient and toxics reduction strategies on a watershed approach.	Continue	Watershed indicators for aquatic systems include water quality as well as components of aquatic systems, biological diversity, hydrologic, and terrestrial systems. This Maryland Integrated Watershed Data and Information System is a cooperative effort between the MD DNR and Dept. of Environment, and provides a comprehensive database of natural resources and biological information for watershed indicators, profiles, bibliography, planning & strategies, and organizations.

2021 Maryland FMP Report (December 2022)
Section 22. Yellow Perch (*Perca flavescens*)

The Maryland Yellow Perch Fishery Management Plan (FMP) was amended in 2018 to better align the plan with current assessment methodologies and subsequent management changes. The amendment was developed with input from the Tidal Fisheries Advisory Commission and Sport Fisheries Advisory Commission, a yellow perch workgroup, and public comment. The amendment revised the management plan objectives, incorporated the status of the stock, and updated the management approach.

Maryland Fishery Management Plan (FMP)

The Maryland Tidewater Yellow Perch Fishery Management Plan (YPFMP), adopted in 2002, improved on the traditional FMP format by including guidelines for ecosystem-based management. Ecosystem-based surveys utilizing yellow perch data have been important in developing guidelines for habitat preservation and land use decisions.[1] Stakeholder meetings were conducted during 2008 to develop objectives for the commercial and recreational fisheries. Maryland's yellow perch fisheries have responded to management actions taken in 2009. The YPFMP was reviewed in 2006 and 2013. The 2013 FMP review recommended an amendment that would include the new management strategies taken in 2009. The amendment process was completed in 2018 with input from workgroups and the two fisheries advisory commissions. Amendment 1 to the Maryland YPFMP revises the management plan objectives, continues important ecosystem management considerations (land/habitat conservation, multi-species interactions and climate change), improves commercial and recreational fishing opportunities, and addresses possible user conflicts.

Stock Status

Based on the 2019 assessment, overfishing is not occurring on yellow perch stocks.[2] There currently is no overfished definition, but estimated biomass is above the long-term average. This suggests that yellow perch stocks are not overfished. Yellow perch stock assessments have been conducted every two years up to 2005, and annually since 2007 for the Upper Chesapeake Bay (includes the Bay and tributaries north of the Bay Bridge, except the Chester River). Biological reference points (BRPs, also known as targets and thresholds) are updated periodically. The Upper Bay population estimate has varied over time from 0.8 million yellow perch in 2014 to 2.5 million in 1998 (Figure 1). The 2021 abundance estimate was 0.53 million yellow perch. The biomass estimate for all age fish in 2019 was estimated at 85,184 kg or 187,798 lbs and in 2020 the biomass estimate was 85,196 kg (187,824 lbs). The biomass estimate in 2021 was 80,109 kg (176,609 lbs) (Figure 2). Biomass in 2017 to 2019 was greater than the time-series average and in 2021 was slightly below average. Total instantaneous fishing mortality (F=0.22) in 2021 was under the biological target F of 0.53 (Figure 3). Age-1 recruitment was extremely poor in 2013, 2014, 2017, 2018, and 2020 and very strong in 2011, 2015, 2016, and 2019. Age-1 recruitment was once again extremely poor in 2021. (Figure 4).

Current Management Measures

After considerable public input during 2008, yellow perch fisheries are managed under a Total Allowable Catch (TAC). The TAC has been allocated 50:50 between the commercial fishery and the recreational fishery since 2009. The TAC is calculated annually based upon the stock assessment to achieve the target fishing mortality rate (F=0.53). The F target is divided in half between the commercial and recreational fishing sectors. Three management areas have been established: the Upper Bay, the Chester River, and the Patuxent River. A management area's commercial season is closed early if the TAC is reached before the scheduled closing date. All or a portion of the overage is subtracted from the following year's allocation. Commercial fishermen are required to have a special yellow perch permit. Daily reporting is required in the commercial fishery, and every fish or box of fish is tagged for accountability, depending on whether or not the fisherman is enrolled in the pilot program. The commercial yellow perch season was expanded to include December of the following year's fishing season. In **2021**, there were **21** participants in the FACTS™ system; they reported their catches electronically. **Five** permittees opted to use individual tags and reported their catches by calling in daily.

The commercial fishery has a slot limit of 8.5 to 11.0 inches, and there are areas closed to commercial fishing. The commercial season is open from December 1 through March 31, unless the TAC is reached earlier. The recreational fishery is open year round, has no closed areas, a minimum size limit of 9 inches, and a creel limit of 10.

The Fisheries

In 2020 and 2021 the commercial quota for the Upper Bay was not reached. The Upper Bay quota in 2021 was 26,135 lbs, of which commercial fishermen harvested 14,338 lbs. The Chester River quota was 4,617 lbs, of which commercial fishermen harvested 4,617 lbs. No yellow perch harvests were reported in 2021 from the Patuxent River (Table 1).

Recreational harvest is largely unknown. It is believed to be within the recreational TAC, but consistently precise estimates are unavailable. The National Oceanic and Atmospheric Administration (NOAA) administers the Marine Recreational Information Project (MRIP). This survey is a coastwide recreational angler survey

that produces recreational harvest and effort estimates. For various reasons, this survey's yellow perch information is generally uninformative, but some years' recreational harvest estimates appear reliable. The most recently reliable estimate was for 2016, when MRIP estimated 64,328 yellow perch were landed by the recreational fishery (MRIP personal communication, 13 September 2018).

Issues and Concerns

Some areas, such as the Severn River, continue to experience poor egg survivorship.[3] Abnormalities in yellow perch ovaries and testes have been documented and may contribute to poor egg and larval viability. Studies have suggested that the abnormalities may be associated with environmental contaminants.

Future stock sizes are expected to decrease over the next few years due to reduced recruitment. Recruitment failure over four of the last six years will begin to effect population levels and TACs. Population declines are due to spawning and larval survival issues, rather than overfishing. However, future commercial TACs and recreational angling catch rates are expected to decline.

Figure 1. Upper Chesapeake Bay yellow perch abundance estimates, 1998 – 2021.

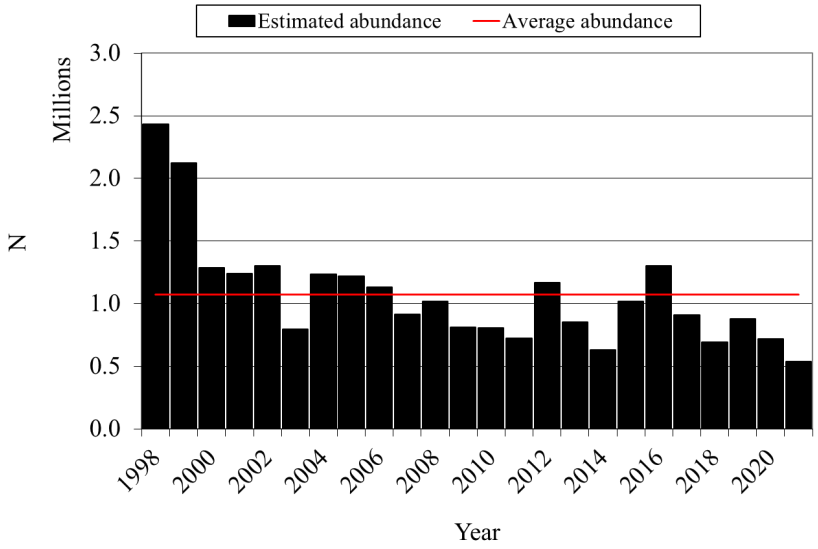


Figure 2. Upper Chesapeake Bay yellow perch biomass estimates, 1998 – 2021.

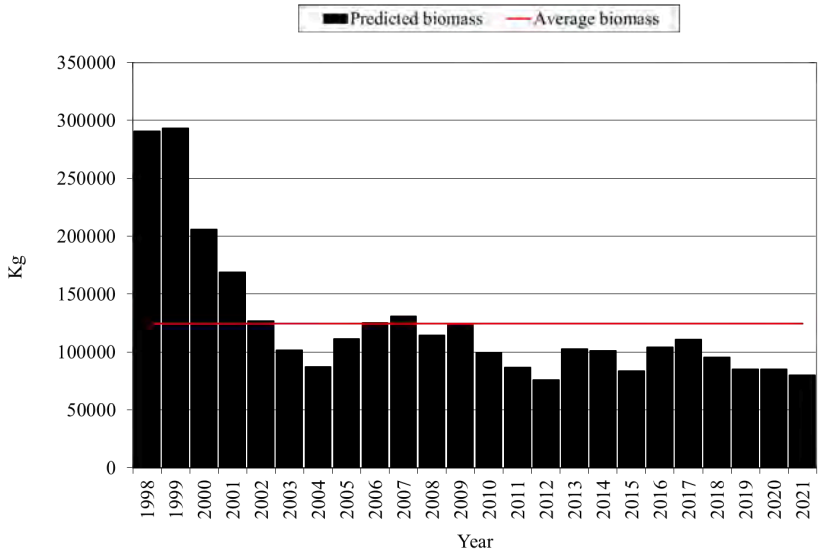


Figure 3. Upper Chesapeake Bay yellow perch fully recruited instantaneous fishing mortality (F) estimates, 1998 – 2021.

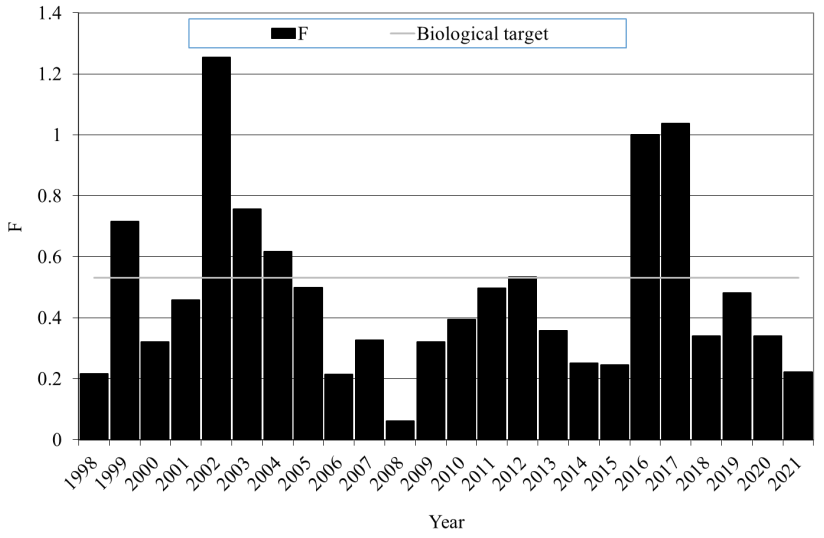


Figure 4. Upper Chesapeake Bay yellow perch recruitment (R, age 1) estimates, 1998 – 2020. Horizontal line indicates time series average.

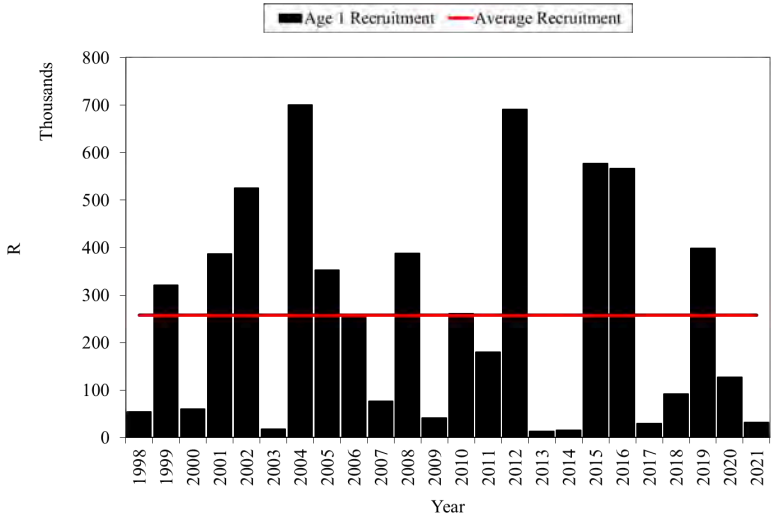


Table 1. Yellow perch commercial quota and harvest (pounds) by management area and year, 2012-2020.

Year	Upper Bay	Chester River	Patuxent River	Total
2012				
Quota	38,950	6,770	2,500	48,220
Harvest	37,193	5,518	1,287	43,998
2013				
Quota	29,800	5,175	2,500	37,475
Harvest	19,518	4,745	1,075	25,338
2014				
Quota	27,200	4,725	2,500	34,425
Harvest	19,305	4,675	1,113	25,093
2015				
Quota	30,489	5,305	2,500	38,294
Harvest	43,478	5,332	1,111	49,921
2016				
Quota	42,189	7,994	2,500	52,683
Harvest	56,501	8,077	330	67,078
2017				
Quota	45,976	10,558	2,500	59,034
Harvest	44,426	6,381	0	50,807
2018				
Quota	59,662	10,381	2,500	72,543
Harvest	33,502	10,290	500	44,292
2019				
Quota	53,368	9,286	2,500	65,154
Harvest	51,737	9,522	0	61,259
2020				
Quota	47,513	8,031	2,500	58,044
Harvest	25,195	4,861	<100	30,156
2021				
Quota	26,535	4,617	2,500	33,652
Harvest	14,338	4,617	0	18,955

References

[1] Uphoff, J.H., M. McGinty, R. Lukacovic, J. Mowrer and B. Pyle. 2009. Impervious surface target and reference points for Chesapeake Bay subestuaries based on summer dissolved oxygen and fish distribution. Fisheries Technical Report Series Number 55. Maryland Department of Natural Resources, Annapolis, MD 21401.

[2] Piavis, P.G. and E. Webb, III. in preparation. Population assessment of Head-of-Bay yellow perch stocks in Maryland. In Chesapeake Bay Finfish and Habitat Investigations. Maryland Department of Natural Resources, Federal Aid Annual Report, F-61-R. Annapolis, Maryland.

[3] Blazer, V., A. Pinkney, J. Jenkins, L. Iwanowicz, S. Minkkinen, R. Draugelis-Dale, and J. Uphoff. 2013. Reproductive health of yellow perch *Perca flavescens* in selected tributaries of the Chesapeake Bay. Science of the Total Environment. 447:198-209.

2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table			
Section	**Action**	**Date**	**Comments**
Implement Ecosystem Considerations	1) Adopt the following ecosystem guidelines:	2001	Refer to comments for each sub-action.
	1.1) Participate in forums, which develop federal or state water quality criteria.	Continue	Refer to the Chesapeake Bay Program (CBP) website for current efforts. Groups addressing tributary strategies and prioritizing watershed activities have been made aware of yellow perch. Yellow perch is a focal species for the Corsica River Targeted Watershed project.
	1.2) Cooperate with the MD Department of Natural Resources (MD DNR) Chesapeake and Coastal Services in the development of watershed assessment surveys, watershed restoration plans, and in the implementation of restoration and enhancement projects.	Continue	Watershed & tributary groups use the Anadromous and Estuarine Finfish Spawning Locations in Maryland, Technical Rept. # 42 (Mowrer & McGinty 2002) during discussions of strategies and actions. To date, 25 watershed restoration action strategies (WRAS) have been developed. Each WRAS includes a watershed characterization report, a synoptic survey (water quality & biological), and a stream corridor assessment. Fisheries staff have been involved in reviewing proposals. Funding for developing additional WRAS ended in 2006. MD DNR, OOS developed the GIS based "blue infrastructure" to identify and prioritize tidal aquatic habitat and connected watershed features. Yellow perch habitat has been included.
	1.3) Participate in the review of permits for projects, which have the potential for significant impact on fishery resources.	Continue	Coordinate with the MD DNR Environmental Review Program (ERP). The ERP typically reviews 2,500 to 3,000 projects per year. During FY'06, over 800 projects were considered for yellow perch impacts. The ERP has been restructured to include representatives from the major units within MD DNR. This new structure should aid in improving coordination on restoration and protection projects. As a result of the 2008 Fisheries Task Force recommendations, the ERP includes FABS staff, and fisheries issues are considered in the process. Efforts to improve the ER process have continued.
	1.4) Cooperate with the CBP and the Atlantic States Marine Fisheries Commission (ASMFC) to develop models, collect and exchange data, and support research projects that explore multispecies management.	Discontinued	MD DNR has provided fishery data for the input parameters of the CBP Ecopath/EcoSim modeling efforts. To date, most of the multispecies initiatives have been focused on migratory species. Yellow perch has not been included in any modeling scenarios, but has been recognized as a priority species from a tributary/watershed perspective. The Fisheries Ecosystem Project has developed a model of Head-of-Bay yellow perch biomass dynamics that incorporates predation and nutrient management impacts. A cooperative MD DNR-NMFS CBP effort to develop a Head-of-Bay Ecopath/Ecosim model was initiated for the Yellow Perch Workgroup, but was discontinued.
	1.5) Develop funding sources for habitat restoration.	2006 Discontinued	No new yellow perch habitat projects have been funded. The Corsica River Project provided some info on watershed management in relation to yellow perch.
	1.6) Develop research proposals to examine habitat fish linkages.	Continue	Impervious surfaces and their impact on aquatic resources (especially fish) are currently under study. There appears to be a 10% IS threshold for fish that also relates to other habitat parameters. Letters of endorsement were supplied for proposals researching habitat and development.
	2) Initiate a Severn River Ecosystem study that focuses on life history stage analysis to assess the effects of degraded habitat on stock abundance.	2001 2005	MD DNR completed field work in 2005. The field results indicated low juvenile survival, low DO and high salinity. Volunteers have been enlisted to monitor yellow perch larvae in the Severn River. These data are incorporated into impervious surface analyses. Severn River habitat has been monitored by the Riverkeeper program (http://www.severnriverkeeper.org)
	3) Use the Yellow Perch FMP as a model for the application of ecosystem-based fishery management	Continue	The Corsica River Project and Mattawoman Watershed Agreement both use the "best management practice" approach. They include a diverse partnership, and strive to minimize development as much as possible. Although Smart Growth is charged with minimizing

	principles and develop new methods of application/implementation.		development, it only addresses infrastructure. Fisheries staff continue to work with citizens and the county government on the importance of aquatic health, and use the Severn River as an example. It is important to identify prime habitat and aquatic resources, and encourage/implement good land management decisions for protection. Impervious surface reference points have been proposed that could directly apply to yellow perch management. Priority habitat areas for fish have been mapped.
Restore Yellow Perch Habitat and Enhance Yellow Perch Populations	4) Use the table on Stock Status and Exploitation and the watershed planning process, to designate yellow perch areas for restoration, maintenance or enhancement and develop specific habitat strategies for each area.	Discontinued	The table was updated, but a more general watershed management approach is necessary. There should be an emphasis on preserving habitat, especially in more pristine areas. Blue infrastructure may aid in determining priority areas for preservation and restoration. The Fish Passage Program continues to collect ichthyoplankton in some historical yellow perch spawning streams. Results are compared with historical yellow perch ichthyoplankton data. The table is no longer used.
	5) Designate the currently closed rivers as yellow perch areas of particular concern, so if resources and funding become available, they can be directed to these areas.	2002 2009	Before 2009, the Magothy, Nanticoke, Patapsco, Severn, South and West Rivers were identified as yellow perch spawning areas because these areas were already closed to harvest, not because they were currently areas of high reproduction. It would be more appropriate to use impervious surface (IS) data and land development projections to identify potential habitat areas of particular concern (HAPC). Most of the identified areas above have high IS values and degraded habitat, except the Nanticoke. Based on current knowledge, Mattawoman Creek should be designated an HAPC. Blue infrastructure may aid in determining priority areas for preservation and restoration. New management strategies for 2009 opened the previously closed areas to recreational fishing only. Migration of yellow perch from Upper Bay areas into the mid-Western shore rivers is responsible for the yellow perch populations in those areas, and removals by recreational fishermen will not reduce recruitment in these rivers.
	6) Form a MD DNR intra- and inter departmental team to implement habitat restoration strategies for yellow perch in prioritized tributaries of the Bay. Coordinate with the Watershed Restoration Action Plans and evaluate five watersheds annually.	2002 Continue	FABS is working with the Tidewater Ecosystem Assessment (TEA) and the WRAS to develop habitat recommendations. A Wye Island Yellow Perch Research and Monitoring Coordination Meeting was held in 2003. The meeting resulted in increased participation with state and federal agencies. The USFWS conducts research on contaminants in yellow perch from different tributaries when funding is available. MDE is monitoring PCBs and mercury from fish samples, and also evaluating disease. The Corsica River Project has been underway since 2005.
	7) Identify essential fish habitat (EFH) for utilizing progressively more detailed information.	Completed	Results from the Impervious Surface Project of the Bush River indicate that stream habitat in developed regions is no longer viable, but yellow perch larvae are abundant in the estuary. These results indicate that other spawning locations may be more critical. Maps have been updated to illustrate essential fish habitat at different life stages.
	8) Facilitate the implementation of habitat management and restoration practices identified as important to yellow perch.	Continue	Working with tributary teams and local riverkeepers, but the scope of work should be broadened. MD DNR will continue to coordinate habitat activities.
Control Fishing Mortality by	9) Adopt BRPs of $F_{35\%}$ and $F_{25\%}$ as a threshold for the yellow perch	2002 Continue	Continuing analysis indicates current BRPs are appropriate. The Maryland Yellow Perch Stakeholder Committee (YPSC) presented recommendations (2007) to evaluate triggers for

establishing biological reference points (BRPs) that describe the targets and thresholds (limits) for yellow perch stocks.	resource. As more data becomes available, the BRPs may be changed to reflect the most current status of the resource.		yellow perch based on stock biomass or age structure, in addition to triggers based on fishing mortality. Triggers were evaluated in 2008. The target fishing mortality rate was (F) = 0.53. The BRPs are updated periodically, using a spawning stock biomass per recruit model. The assessment model was refined by adding more years of data (2011-2017), re-examining fishery independent indices and weightings, and expanding the range of ages.
	10) Adopt the decision rules for managing the yellow perch resource based on the target and threshold mortality rates and utilize the decision rules to make recommendations regarding the yellow perch systems currently under assessment.	2002 Continue	Decision rules have been adopted. Based on a target fishing mortality rate (F=0.53), a 2018 Chesapeake Bay TAC was calculated. The 2020 quota for the Upper Bay commercial fishery was 47,513 lbs, the Chester River quota was 8,031 lbs, and the Patuxent River quota was 2,500 lbs. Improving catch reporting included daily call-ins, verified by tagging. These measures were implemented in 2009 to improve accountability and have continued through 2020.
	11) Utilize Table 1 of MD Yellow Perch FMP to guide the development of management strategies and actions for selected river systems, within the MD portion of the Bay.	Periodically Updated Discontinued	Management actions may include size limits, creel limits, closed seasons, area closures, and/or gear restrictions. The table was updated (2006) but needs to be reexamined for its usefulness in guiding management strategies. Starting with the 2009 season, the annual stock assessment will determine the strategies and actions for three management areas – the Upper Bay, Chester River, and Patuxent River for commercial fishing. The stock assessment, creel surveys, and public input will help determine strategies and actions for the recreational fishery.
	12) Continue the 8.5 -11inch slot limit for the commercial fishery in all open areas and adjust fishing mortality (F), depending on the most recent stock assessment.	2000 Assessed annually	Slot limit has not changed and is currently in place. Analysis was conducted and evaluated. Slot limit was selected to be the most robust approach. Fishing mortality was below targets in all years. No changes in management recommendations. During stakeholder meetings in 2008, the slot limit was widely supported.
	13) Continue the uniform recreational minimum size limit of 9 inches in all open areas. Adjust size and/or creel limits depending on the most recent stock assessment.	2000 Assessed annually	The 9-inch size limit is still in effect. Fishing mortality was below the target in all years. No changes in management recommendations. Based upon recent stock assessments, the creel limit was increased from 5 to 10 yellow perch, effective with the 2009 recreational season.
User Conflicts	14) Establish an ad hoc yellow perch committee comprising stakeholders to provide input into the yellow perch management process.	2001 Continue	The ad hoc group will meet as necessary. The Sport Fisheries & Tidal Fisheries Advisory Committees will also consider new recommendations. Stakeholder meetings held in 2008 produced compromises that allow both quality recreational fishing and a limited commercial fishery. The ad hoc group met during 2016-2017 to discuss the best way to handle commercial quota overages, an action in Amendment 1.
Examine the conflict between commercial and recreational uses of yellow perch.	15) Evaluate the utility of a web-based volunteer angler survey to collect data on the recreational fishery, and implement the survey if feasible.	2002	A pilot program to utilize angler logbooks was implemented, but the anglers did not return any information. The program was discontinued. A web-based angler survey was implemented in 2008 and continues. The information provided by anglers in 2012 showed a decrease in the catch per angler hour (CPAH). Shoreline anglers reported the same CPAH as in 2010 and 2011, while boat anglers reported lower catch. Anglers exceeded average reported catches in the Bush, Wye, Northeast, Susquehanna, Patuxent, Chester, and Middle Rivers. The full results can be viewed at: http://dnr2.maryland.gov/Fisheries/Pages/survey/index.aspx

Identify any problems and recommend solutions.	16) MD DNR has implemented a system to track the use of pound nets in the Bay. Evaluate the pound net system for tracking fyke nets and make recommendations for their use.	2003 2008 2009	Fixed gear restrictions are county specific. MD DNR has done unofficial counts of fyke nets, and over the last few years the number of fyke nets has decreased. The number of nets is recorded on the reporting form, but it is difficult to get effort data. Regulations to prohibit the use of fyke nets in tributaries upstream of the first 200 ft. channel width during the month of February were implemented for 2008. The width limit was changed in 2009 to a geographic and temporal restriction by area. Fyke nets were legally defined in 2009.
	17) If fishing mortality is too high in relation to the adopted targets, strategies to reduce fishing effort will be explored. Topics to be considered include, but are not limited to: capping the number of fyke nets per fishermen, the placement of fyke nets in river systems (i.e., total number per river system; distance between nets); daily harvest restrictions, and seasonal quotas.	As necessary	When targets have been exceeded, these types of management strategies to reduce fishing effort will be evaluated. Total Allowable Catch (TAC) is calculated based on the latest stock assessment. Allocation of the TAC between commercial fishing and recreational fishing is determined after considering input from stakeholders. The public notice required to close the commercial fishery has been reduced from 48 hours to 24 hours.
	18) Evaluate the need for increased enforcement of yellow perch regulations, develop strategies to meet the needs and implement actions accordingly.	2001 Continue	NRP makes a special effort to enforce yellow perch regulations during spring spawning run. They also conduct a yellow perch creel survey based on random stops and interviews, mostly at road crossings.
Stock Status: MD DNR will monitor yellow perch stocks in representative areas of the Chesapeake Bay, in order to assess yellow perch stock status.	19) Continue to sample commercial and recreational harvest of yellow perch, and collect basic biological data. Additional biological data may indicate changes in the status of the stocks, and require additional management measures.	Continue	The Chesapeake Finfish Program (previously FS Multispecies Project) collects yellow perch data from commercial and experimental fyke nets, seine and trawl surveys, and uses data to periodically assess stocks. The estimated Upper Chesapeake Bay population abundance was 2.2 million fish in 2016. Recruitment has increased from estimated 207,000 (2011) to 800,000 (2016). Recruitment was well below the long-term average in 2013 and 2014. It was nearly twice the long-term average in 2015 and 2016.
	20) Develop a method for evaluating yellow perch recruitment, and utilize it as one of the parameters for assessing stock status and consequent management actions.	2003	Yellow perch recruitment has been monitored on the Severn River, but is no longer a priority. MD DNR utilizes the EJFS in the upper Bay for information on recruitment. Larval survey methods are being evaluated for use in tributaries. The Nanticoke, Bush, Corsica and Severn rivers were sampled in 2006. A YOY index is calculated for the Choptank, Nanticoke, Potomac and Patuxent rivers and the Head of Bay.
	21) Yellow perch egg strands are easy to collect, and important for hatchery and/or aquaculture endeavors. Maryland will prohibit the removal or selling of egg chains that have been	2001 2005	A person needs a Scientific Collection Permit as described in Natural Resources Article, §08-02.12.02, of the Annotated Code of Maryland, to collect yellow perch eggs. Effective Feb. 2005, a person may not catch or possess yellow perch eggs from any state waters (08.02.05.07F).

	stripped by artificial methods, unless a scientific collection permit has been issued.		
	22) Evaluate additional fishery-independent indicators of stock status, such as the trawl survey in the upper Bay.	Continue	Current estimates of stock status are based on data from the Upper Bay and Choptank.
	23) Review and evaluate yellow perch monitoring efforts biannually. Recommend changes in monitoring and protocol necessary to implement the yellow perch FMP.	2002 Continue	Evaluated annually. Added Marshyhope River to fyke net sampling schedule. Contracted with CBL to do a 2008 yellow perch creel survey in Bush River, Mattawoman Creek, Wicomico River (western shore), and Chester River. Additional rivers were surveyed in 2009 – Chester, Bush, Northeast, Patuxent, South, Magothy and 3 tributaries of the Potomac (Mattawoman Ck., Nanjemoy Ck., Wicomico R.). Funding for this creel survey was cut for 2010. MD DNR conducts fishery independent and dependent surveys. Fisheries independent efforts include the Upper Bay Winter Bottom Trawl Survey (Sassafras River, Elk River, Upper Bay, Mid-Bay, in 2011) and Choptank River Fishery Independent Sampling. Fishery dependent efforts include Upper Chesapeake Bay fyke net surveys (Gunpowder River, Back River and Middle River vicinities), and Nanticoke River fyke and pound net surveys.
Yellow Perch Outreach MD will continue outreach efforts to engage fishing and non-fishing communities in stewardship of the yellow perch resource in tributary basins.	24) Utilize volunteers from the recreational fishing sector, such as the Coastal Conservation Association or watershed community associations, to obtain recreational data in areas not sampled by the MD DNR Multispecies Project. Explore the use of a volunteer recreational survey using the web similar to the recreational survey implemented for striped bass.	Continue	Dependent on volunteer recruitment. The volunteer angler survey did not generate any response, and was discontinued. A web-based angler survey has been produced, and was implemented in 2008. CCA and MSSA will be asked to promote angler participation. Access to the survey and summaries from 2010, 2012 and 2016 can be viewed at: http://dnr.maryland.gov/fisheries/Pages/survey/yellow-perch.aspx
	25) Add yellow perch egg strand sampling in the early spring to river basins with volunteer monitoring programs to obtain data on yellow perch spawning locations.	Continue	CCA conducts stream walks utilizing citizen volunteers. The information is used to indicate spawning presence, although zero egg sightings does not mean there is no spawning in a particular system. Shifts away from “traditional” spawning locations may be indicative of habitat degradation, and subsequent shifts by spawning yellow perch to more suitable spawning habitats
	26) MD DNR will continue to partner with the Yellow Perch Hatch, Raise and Release Project by providing assistance and advice in the collecting, raising, releasing, and stocking of yellow perch in all facets of the project.	Discontinued	Arlington Echo Outdoor Education Center reported poor viability of Severn River yellow perch eggs, preventing such a program. Focus has changed to bluegill and hybrid sunfish as educational tools.

	27) MD DNR Fisheries Outreach will explore new avenues to involve the public in yellow perch projects, such as a new exhibit on identifying yellow perch egg strands, and collecting information on their occurrence and distribution: cooperative efforts with the Team program, and volunteer monitoring opportunities.	Continue	Volunteer monitoring has occurred in the Bush, Severn and Corsica to monitor eggs, larvae and juveniles, and to assess aquatic health (water quality). FABS staff continue to give presentations to fishing clubs, environmental organizations, etc. upon request.

Acronyms

ASMFC – Atlantic States Marine Fisheries Commission
BRPs – Biological Reference Points
CBL – Chesapeake Biological Laboratory
CBP – Chesapeake Bay Program
CCA – Coastal Conservation Association
CPAH – Catch Per Angler Hour
DO – Dissolved Oxygen
EFH – Essential Fish Habitat
EJFS – Estuarine Juvenile Finfish Survey
ERP – Environmental Review Program
F – Fishing mortality
FABS – Fishing and Boating Services
FACTS™ – Fishing Activity Commercial Tracking System
FMP – Fishery Management Plan
FY – Fiscal Year
GIS – Geographic Information System
HAPC – Habitat Areas of Particular Concern
IS – Impervious Surface
MD DNR – Maryland Department of Natural Resources
MDE – Maryland Department of the Environment
MSSA – Maryland Saltwater Sportfishermen Association
NMFS – National Marine Fisheries Service
NRP – Natural Resources Police
OOS – Office of Sustainability
PCB – Polychlorinated Biphenyl
TAC – Total Allowable Catch
TEA – Tidewater Ecosystem Assessment
WRAS – Watershed Restoration Action Strategies
YPSC – Yellow Perch Stakeholder Committee

2017 Amendment 1 to the 2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table			
Strategy	**Action**	**Date**	**Comments**
Ecosystem Management Considerations 1. Ecosystem guidelines will continue to be refined for all phases of yellow perch management ,with habitat and invasive species interactions as the primary ecosystem management focus.	1.1. Adopt the use of Impervious Surface (IS) reference points in watershed planning and fisheries management. Educate citizens and county government officials about the ecological and economic importance of aquatic health, identification of prime habitat and aquatic resources, and encourage them to implement land management decisions for aquatic resource protection. 1. Work with county staff when developing their comprehensive plans to conserve priority habitats. 2. Work with local governments, counties, the Maryland Department of Natural Resources, and state agencies to keep farming and forestry viable and manage development. 3, Continue to support the outcomes and actions from the Chesapeake Watershed Agreement (2014) that conserve vital habitats and maintain viable habitat functions.	2017	FABS is utilizing the IS guidelines as follows: in areas with <5% IS – preserve watersheds from development; at 5-10% IS – utilize more stringent fishery regulations to compensate for habitat stress: >10% IS – habitat stress increases, and successful management by harvest adjustments alone become unlikely. FABS staff promotes BMPs that are associated with positive post-larval survival, such as conservation tillage and cover crops. Staff continue to work with local county, state and federal partners to conserve vital habitats.
	1.2. Partner with other Maryland Department of Natural Resources units, especially the Environmental Review Program and the interdisciplinary teams, such as the Invasive Species Matrix Team, to assess watersheds, and establish priority habitat areas for protecting yellow perch spawning and nursery areas.	Continue	Priority habitat area maps have been developed, and are used during the environmental review process.
	1.3. Participate in relevant forums, especially through the Chesapeake Bay Program, to improve the effectiveness of fish habitat conservation and restoration efforts, and implement baywide climate change strategies.	Continue	FABS staff participate in several CBP workgroups including sustainable fisheries, habitat, water quality, and climate resiliency. Cross workgroup interactions are supported whenever possible.
	1.4. Utilize the environmental review process to prevent the destruction of designated high-quality habitat, both in the short-term and the long-term. Emphasis should be placed on preserving habitat in more pristine areas.	Continue	FABS staff regularly participate in the environmental review process. Key personnel have been designated, and habitat conservation/preservation in high quality areas is promoted.
	1.5. Promote/support zooplankton monitoring with the goal of understanding the relationship between zooplankton abundance and larval/early juvenile fish survival.	Continue	Staff promote zooplankton monitoring whenever possible especially in forage discussions, and predator/prey interactions.
	1.6. Consider the role and potential impacts of invasive species on all life stages of yellow perch, and mitigate the ecological impacts where feasible.	2017	Staff attended a blue catfish symposium geared at assessing potential impacts of blue catfish colonization of Chesapeake Bay tributaries. Upper Chesapeake Bay trawl survey and Choptank River fyke net survey are utilized to document invasive fish species.
	1.7. Consider climate change in yellow perch management planning to the extent that information is available.	Continue	Climate change impacts are considered to the extent possible.

Stock Assessment: 2. The status of the yellow perch stock will be evaluated through periodic stock assessments using monitoring data, best available scientific methodology, and ecosystem considerations to guide yellow perch fishery management.	2.1. Continue fishery dependent and fishery independent monitoring for yellow perch, and collect biological data to inform stock assessments. Utilize supplemental data, when available, such as the Upper Chesapeake Bay trawl survey, to provide additional information for managing the stocks.	2000 Continue	Chesapeake Finfish Program collects data from commercial and experimental fyke nets, seines and trawls and uses data to assess stocks.
	2.2. Conduct a stock assessment annually, and periodically review the stock assessment methodology to make improvements/adjustments as needed.	2009 Continue	Estimated biomass has been slightly above average in 2017-2019.
	2.3. Utilize biological reference points (BRPs) to assess the status of the yellow perch stock, and update the BRPs as necessary to account for conservation needs and measures of uncertainty in the models.	2009 Continue	Periodically updated as appropriate.
Commercial Fishery: 3. Utilize a conservative and risk-averse approach to the calculation of an annual total allowable catch (TAC) as the primary method to control fishing mortality (F) and incorporate ecosystem considerations when feasible.	3.1. Calculate fishing mortality (F) annually as part of the stock assessment.	2009 Continue	Fishing mortality is calculated annually as part of the assessment process. During 2020, fishing mortality was low. Fishing mortality has not approached the biological F target (BRP) since the adoption of TAC.
	3.2. If commercial harvest exceeds the annual total allowable catch (TAC), all or a portion of the overage will be subtracted from the TAC the following year: 1. If the overage is less than 10% of the adjusted TAC, it will be subtracted pound for pound from the following year's TAC. 2. If the overage exceeds the adjusted TAC by 10% or more, it will trigger a review of the status of the stock. MD DNR staff will meet with the Yellow Perch Workgroup to review the status of the stock, and develop recommendations on how the overage will be addressed, including biological and economic considerations.	2018	Commercial harvest did not exceed TAC in either 2017 or 2018.
	3.3. Maintain the 8.5 to 11.0-inch slot limit for the commercial fishery in all open areas. Adjust size limits if stock assessments	2000 Assessed annually	Slot limit has not changed and is currently in place.

	indicate adjustments are necessary, with input from stakeholders.		
	3.4. Maintain geographic management units for the commercial fishery, based on the stock assessments. Currently, the management units are: Upper Chesapeake Bay, Chester River and Patuxent River. Consider expanding areas if data becomes available.	2009 Continue	The geographic management areas for the commercial fishery are the same since the onset of the quota management system put in place in 2009. At this time, data from other areas is very limited, which does not substantiate expanding the fishery into those areas.
	3.5. Implement a harvest reporting system that ensures accountability, and update total harvest on a daily basis. When the total allowable catch (TAC) is projected to be reached before the season end date, close the commercial fishery.	2009 Continue	In 2009, the first year that commercial harvesting of yellow perch was placed under a quota system, fishermen were required to tag individual yellow perch and call in their harvest each day. Presently, fishermen can either tag individual fish and call in their harvest each day, or place box tags on containers and report electronically each day. Information on the box tags is to include license number, date, area fished, estimated weight, actual weight and number of fish in each container.
	3.6. Identify commercially harvested yellow perch using a tagging system as an additional method of ensuring accountability.	2009 Continue	See above.
	3.7. Promote the use of electronic reporting to improve the timely and accurate collection of harvest data.	2016 Continue	In 2016, a pilot program was initiated where commercial fishermen could use box tags, rather than tagging individual fish, if they agreed to report their catch electronically.
	3.8. Continue to enforce yellow perch regulations and statutes. Utilize the Penalty Workgroup, a subcommittee of the Tidal Fisheries and Sport Fisheries Advisory Commissions, to establish a point system that includes violations of commercial and recreational yellow perch rules that may include both temporary suspensions and loss of participation in the fishery.	Continue	With the majority of commercial fishermen reporting electronically, NRP can now meet them at their reported offloading location to monitor their harvest.
Recreational Fishery: 4. Continue to provide opportunities for the yellow perch recreational fishery.	4.1. Explore ways to increase recreational harvest accountability and fishing opportunities.	Continue	APAIS recreational interview system is now handled by FABS. Various dam removal projects may increase yellow perch availability, and therefore increase fishing opportunities.
	4.2. Continue to promote participation in the Maryland Department of Natural Resources on-line angler survey.	Continue	Response levels continue to wane. Currently, data is of limited value.
	4.3. Adjust size limits and creel limits as needed to meet established targets, and consider stakeholder input when changing regulations.	Continue	Although not specifically part of the annual assessment, creel and size limit adjustments are potential management options.
	4.4. Continue to enforce yellow perch regulations and statutes. Utilize the Penalty Workgroup, a subcommittee of the Tidal Fisheries and Sport Fisheries Advisory Commissions, to establish a point system that includes violations of commercial	Continue	NRP makes a special effort to enforce recreational yellow perch regulations during the spring spawning run as access points along popular fishing destinations

	and recreational yellow perch rules that may include both temporary suspensions, and loss of participation in the fishery.		
	4.5. Estimate catch and effort from the recreational fishery when data, funding and personnel are available.	Not initiated	Dedicated creel surveys are expensive and funding was not available in 2017.
Reduce User Conflicts: 5. Respond to user conflicts by providing a forum for discussion and the transparent development of actions, when necessary.	5.1. Continue to review and respond to possible user conflicts through the Sport Fisheries Advisory Commission and Tidal Fisheries Advisory Commission meetings and briefings. Establish ad hoc groups as necessary to address specific issues when they occur.	Continue	A yellow perch workgroup was convened with appointees from TFAC and SFAC. Recent meetings discussed formal rules for reducing TAC should commercial fishery exceed previous year's TAC, impacts of potential regulation changes, and finalization of the yellow perch FMP amendment.
Chesapeake Watershed Agreement: 6. Continue to partner with the Chesapeake Bay Program to protect and conserve living resources of the Chesapeake Bay.	6.1. Coordinate with the Chesapeake Bay Program partners to address habitat and living resource issues, especially actions that impact yellow perch.	Continue	MD DNR staff work on baywide fishery and habitat issues through the CBP. Yellow perch habitat concerns are promoted as appropriate.

Acronyms

APAIS – Access Point Angler Intercept Survey
BRP – Biological Reference Point
CBP – Chesapeake Bay Program
FABS – Fishing and Boating Services
IS – Impervious Surface
MD DNR – Maryland Department of Natural Resources
NRP – Natural Resource Police
SFAC – Sport Fisheries Advisory Commission
TAC – Total Allowable Catch
TFAC – Tidal Fisheries Advisory Commission

2021 Maryland FMP Report (December 2022)
Section 23. Brook Trout (*Salvelinus fontinalis)*

Introduction

There has never been a Maryland commercial fishery for brook trout based on historical reports (Powell 1967). Maryland's brook trout populations are managed as a freshwater recreational fishery.

Brook trout were the trout species cultured at Maryland's first hatchery facility, located in Druid Hill Park in Baltimore City. Initial production began in 1877. The production and stocking of brook trout in Maryland continued at varying levels through 1987, when all stocking of brook trout was discontinued. In the early years of the program (1870's to mid-1900's), it is estimated that millions of fingerling brook trout were stocked statewide. In the late 1940s through the 1980s, improved stocking records were kept, and the majority of fish stocked were catchable-size brook trout as part of an annual stocked trout fishery. During the period of 1948 to 1987, 1.27 million brook trout were stocked in Maryland waters (state and federally produced fish). Although state production of brook trout ended in 1976, Maryland continued to receive brook trout from federal hatcheries until 1987, when stocking was discontinued. Fortunately, the results of comprehensive genetic work on Maryland brook trout populations indicate that stocked fish did not integrate with naturally occurring populations, and our existing populations are reflective of natural stocks (Morgan et al. 2002).

Brook trout is the only native salmonid in Maryland. Like the lake and bull trout, brook trout are members of a group of fish known as charr, the English name given to all members of this genus. Brook trout are typically found in Maryland's more pristine and remote areas because of their habitat and life history requirements (Heft et al. 2006). They are considered an indicator species, representative of a whole suite of unique aquatic and terrestrial organisms that occupy and share the same habitat. An iconic symbol of clean water and healthy aquatic systems, brook trout are the aquatic "canary in the coal mine." If water quality and habitat are degraded, brook trout will quickly be extirpated. As a result, brook trout have been a catalyst in the eastern United States for the conservation and restoration of native coldwater fishery resources specifically, and a poster child for fishery and water resources conservation in general. In Maryland, this movement began in 2006 with the development of a statewide Brook Trout Fisheries Management plan (BTFMP); https://dnr.maryland.gov/fisheries/documents/MD_Brook_Trout_management_plan.pdf

The development of the BTFMP in 2006 coincided with the creation of the Eastern Brook Trout Joint Venture (EBTJV), a multi-partner effort of state and federal government agencies, academic institutions, and non-profit angling and conservation groups, to increase awareness and promote conservation and restoration of brook trout in their native eastern United States range (http://easternbrooktrout.org/). This was followed in 2014 by the addition of a specific brook trout outcome in the Chesapeake Watershed Agreement, an important step in raising the profile of brook trout conservation in the Chesapeake Bay watershed. http://www.chesapeakebay.net/chesapeakebaywatershedagreement/page

The decline of brook trout populations in Maryland has been significant. Brook trout have been eliminated from an estimated 62% of their historic habitat in Maryland, and most of the remaining populations are considered greatly reduced, occupying less than 10% of their historic range (Hudy et al. 2008). Wild brook trout populations are generally relegated to headwater streams, where human disturbance is minimal, and forest cover is still prevalent. The only subwatershed in Maryland that is considered "intact" (brook trout present in > 90% of historical habitat) is the Upper Savage River watershed (USR), located in western Maryland (Garrett County). The USR is considered the last remaining stronghold for brook trout in Maryland, and one of the only unfragmented brook trout areas in the entire mid-Atlantic region. Brook trout populations east of Garrett County are highly fragmented and greatly diminished from their historic range. Of the remaining 47 subwatersheds where brook trout still occur in central and western counties, 10% are "reduced" (only 50% to 90% of historic habitat occupied), and the majority (90%) are "greatly reduced" (only 1% to 50% of historic habitat occupied). One of the major difficulties in managing brook trout in Maryland is that most habitat is located on private land or on a mix of private/public lands. Only 11% of all brook trout streams are fully within state lands.

Opportunities to reestablish extirpated brook trout populations are limited, particularly in the eastern and central portion of the state where anthropogenic impacts of human population growth continue. However, strengthening existing populations in these areas through habitat restoration and conservation projects can be a realistic goal for some of these streams. In western Maryland, there are opportunities to reestablish extirpated populations in streams where water quality has been degraded by relict mining impacts from acid mine drainage (AMD), but the physical habitat remains suitable. Since the implementation of the BTFMP, two brook trout reintroductions have occurred in streams where mitigation of AMD impacts has sufficiently improved water quality. Both streams are in Garrett County, Aaron Run (Savage river watershed) and Winebrenner Run (Georges creek watershed). In addition, AMD mitigation was completed in the Mill Run watershed. Projects are ongoing in the Casselman River watershed where the goal is to improve water quality and increase brook trout population density, distribution, and

connectivity. In the eastern portion of Maryland, Trout Unlimited is leading an effort with state and federal partners to restore brook trout to the upper Gunpowder River watershed.

The Maryland Department of Natural Resources (MD DNR) Wildlife and Heritage Service lists brook trout on the "Rare, Threatened, and Endangered Animals" list (https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/rte/espaa.aspx). They are ranked as S3S4. The S3 ranking places some brook trout populations on the "Watch" list, defined as rare to uncommon with the number of occurrences typically in the range of 21 to 100. They may have fewer occurrences but with a large number of individuals in some populations, and they may be susceptible to large-scale disturbances. Species with this rank are not actively tracked by the Wildlife and Heritage Service. The S4 ranking places some brook trout populations as "Secure" with typically more than 100 occurrences, or may have fewer occurrences if they contain large numbers of individuals. Brook trout in this category are apparently secure under present conditions, although they may be restricted to only a portion of the state. Brook trout are also listed as a "Greatest Conservation Need" (GCN) species in Maryland's Wildlife Diversity Conservation Plan and as a Regional Species of GCN by the Northeast Regional Synthesis for Conservation Need.

While important from a conservation and aesthetic standpoint, brook trout are also an important recreational resource managed by the MD DNR Freshwater Fisheries Division. Trout fishing in Maryland is a popular recreational activity, with a variety of options available to anglers. Besides brook trout, there are fishing opportunities supported by the stocking of rainbow and brown trout. Both are introduced trout species that have been successfully domesticated for hatchery production. There is a large and passionate group of anglers who prefer to pursue only native trout where they still occur statewide.

During 2020 substantial progress was made towards brook trout conservation and accomplishing goals in the 2006 Brook Trout Fishery Management Plan (BTFMP). Staff completed the initial statewide brook trout patch assessment to determine the overall resiliency of our remaining brook trout patches. The intent of this effort is to identify the most resilient brook trout populations in the state and direct future brook trout conservation/restoration work to areas that provide the best opportunity for the long-term persistence of brook trout. Results from the patch assessment identified 10 streams statewide that met four of the five rating criteria (listed below). These ten streams are considered our most resilient populations in the state and are targeted for future habitat restoration work. This information has been updated on our Coldwater Resources Mapping Tool and is available to anyone on our website. Subsequent brook trout monitoring is being directed by data gaps in the patch assessment. For instance, streams that do not have genetic information or enough years of sampling to complete abundance estimates are being targeted for sampling in upcoming field seasons. This will provide a more comprehensive patch assessment.

Brook trout program staff also worked with the Maryland Forest Service to produce two riparian buffer management pamphlets for landowners. This was an effort to inform landowners about proper maintenance of their stream side buffers and the resulting benefits to brook trout and other coldwater species.

Work was also completed in the Savage River watershed looking at temperature and flow contributions from seven tributaries to the mainstem. Results indicated that the Little Savage River and Poplar Lick contribute the majority of cold water to the mainstem during summer low flow periods, while Mudlick is an apparent heat source. A final report will be completed in 2021.

Staff also worked to draft and pass catch and release fishing regulations for brook trout in all waters east of Interstate 81 and all put and take waters west of I-81. Statewide regulations remain in place for all other waters west of I-81. These new regulations went through two public scoping periods with over 95% of public comments supporting the regulations. These regulations became effective January 1, 2021.

Stock Status

Brook trout populations have been declining throughout their native range (Maine to Georgia) in the eastern United States, and Maryland's populations are no exception. A 2006 assessment of brook trout status in 1,443 subwatersheds (sixth level hydrologic unit) located in the Chesapeake Bay watershed resulted in 226 subwatersheds (16%) being classified as *Intact* (brook trout are present in >50% of the streams), 542 (38%) were classified as *Reduced* (brook trout are present in ≤50% of the streams), and 290 (20%) were classified as *Extirpated* (brook trout no longer exist in the streams) (Hudy et al. 2008). Additionally, an approach was developed that assists with identifying subwatersheds with the greatest potential for successful brook trout protection, enhancement, or restoration actions (Hanson et al. 2014). In the Chesapeake Bay watershed there are only 103 *Intact* subwatersheds and 43 *Reduced* subwatersheds that are assigned high priority scores (≥0.79) for potential restoration, only one of which is in Maryland. A 2015 Maryland update to the initial 2006 assessment, and focused at a finer geographic scale (Mark Hudy, personal communication), showed that 72% of historic brook trout populations are *Extirpated*, 27% persist at a *Reduced* level, and only 1% are considered *Intact*. Maryland's only *Intact* watershed is the USR system, and it is one of the best brook trout systems in the mid-Atlantic region. Intensive monitoring occurs annually in the USR. Figure 1 shows the watersheds where brook trout historically occurred in Maryland, and Figure 2 shows the current distribution as of 2018.

A finer scale assessment of brook trout populations in the Chesapeake Bay watershed was completed (2012 to 2014) by the EBTJV to provide natural resource managers with better tools for detecting population changes, and setting conservation priorities. This assessment entailed determining wild brook trout occupancy at the catchment scale (basically a single stream scale), which was used to identify brook trout patches (Whiteley et al. 2013). A "patch" is defined as a group of contiguous catchments occupied by wild brook trout; patches are not connected physically (i.e., they are separated by a dam, unoccupied warm water habitat, downstream invasive species, etc.), and are generally assumed to be genetically isolated. The assessment found that there were 3,608 "Wild Brook Trout Only" patches in the Chesapeake Bay watershed, and only 166 patches in Maryland (4.5%).

In 2014, the Brook Trout Program (BTP) staff developed a 5-year (2014 to 2018) sampling schedule to update the status of all historically known and suspected brook trout populations statewide. This monitoring effort included sampling to determine at least the presence or absence of brook trout. The results are used to annually update the statewide stock status of brook trout data layer, that is vital to future restoration and monitoring efforts, including the Bay Program's Brook Trout Outcome goal. Additionally, the survey results will be used to develop a long-term restoration plan by directing restoration efforts to areas where brook trout populations are extirpated. A total of 120 streams statewide were sampled in 2017 and 90 were sampled in 2018, completing the planned 5-year sampling schedule (Table 1).

Anthropogenic impacts have been identified as the primary reason for the documented declines in brook trout. Increasing urbanization, deforestation, exotic species, and mining have been identified as a few of Maryland's most imminent threats. Likewise, the future of Maryland's brook trout populations remains uncertain in the face of increasing water temperatures in response to climate change.

Status of the Fishery

The statewide recreational creel limit for brook trout in 2020 was 2 per person per day, with no minimum size and no closed season, except in special trout management and put-and-take areas. There is no commercial harvest for brook trout. Maryland's premier brook trout fishery occurs in Garrett County in the USR mainstem and tributaries upstream of the Savage reservoir dam. This system supports the highest population densities and largest brook trout in the state. The streams are managed under catch and release rules, with angling restricted to using artificial lures only. Intensive monitoring of this fishery has occurred annually since 2006.

In 2017, a wild trout angler preference survey (Heft 2017) was completed by the BTP in conjunction with a statewide general freshwater angler survey (Knoche 2017). A portion of the wild trout survey was designed to obtain information relating to anglers' views on management and regulatory strategies for brook trout statewide and the USR fishery. Relevant findings from the wild trout survey conclude that Maryland wild trout anglers are generalists regarding their angling method, and they target wild trout and stocked trout. The majority (92.4%) of respondents support the USR brook trout special management regulation, and 77.8% of respondents believe the USR fishery has improved since the regulation was implemented. Support for more conservative brook trout regulations statewide is strong. Anglers favor catch and release only, tackle restrictions, and do not support "put and take" stocking where wild brook trout occur. The option to harvest brook trout was the least important aspect of what anglers' value, further supporting the value of brook trout fishing as non-consumptive and mainly recreational. The general statewide survey included information on the economic value of the brook trout fishery to Maryland. Over 74,000 fishing trips occur annually on statewide brook trout streams with an estimated annual economic value of over $9,000,000.

During 2018 the first ever statewide synoptic survey of brook trout populations was completed (Sell and Heft 2019). Statewide a total of 456 catchments were identified as being occupied by brook trout historically. Of those, 440 were sampled (including predicted presence) during the reporting period, representing a 96.5% completion rate. All 550 individual survey sites were sampled for brook trout occupancy and brook trout were collected at 405 of those sites. Brook trout were collected in 263 of the historically occupied catchments and are now classified as "Currently Present." An additional 54 catchments are now classified as "Predicted Present" and are hereafter considered to be occupied catchments. No brook trout were collected in 123 catchments and are now classified as "Currently Not Present/Unknown", suggesting a 27.0% decline statewide in occupied catchments from the historical distribution (Figure 2). A summary of statewide and regional occupancy data can be found in Table 2.

Historically, brook trout occupied an estimated 2,038.5 kilometers (1266.7 miles) of streams west of the fall line, including streams outside of the Chesapeake Bay watershed. Currently, brook trout occupy 1,376.2 stream kilometers (855.1 miles) west of the fall line and are considered to be historically present in an additional 114.4 stream kilometers (71.1 miles). This equates to a loss of 547.8 kilometers (340.4 miles) and a 26.9% decrease in occupied stream length. Currently, brook trout occupy 7.4% of the total stream kilometers west of the fall line in Maryland.

Patch Assessment - Rating Criteria

1. **The brook trout patch should contain an allopatric brook trout population.**

   Definition: A watershed of any scale ≥ 14 digit Hydrologic Unit Code that is classified as an allopatric brook trout habitat patch, as defined by the latest Eastern Brook Trout Joint Venture assessment, will satisfy this criteria. Allopatric populations consist of only brook trout and no exotic trout species are present either as wild or stocked populations (e.g. brown trout and rainbow trout).

2. **The brook trout patch should have a strong, stable base population.**

   Definition: Adult brook trout densities are ≥ 75th percentile of average adult (> 100 millimeters) brook trout densities (fish/kilometer) in Maryland with a minimum of three years or discrete locations of data. For patches with four or more samples, the highest three densities were used to get the representative average density for that patch. The three highest densities were chosen to represent the productivity potential of the patch, to buffer against the natural variability common among brook trout populations, and to avoid biasing against patches with long sampling histories. Densities are based on two or three pass depletion estimates.

3. **The brook trout patch should have a strong Effective Population size (Ne).**

   Definition: The watershed/patch should have an Ne of >50 individuals (i.e., those individuals that contribute unique genetic information to the population). The effective population size is the number of individuals that effectively participate in producing the next generation and is an important metric for determining the genetic 'health' and/or resiliency of a population.. Generally the effective size of a population is considerably less than the census size.

4. **The brook trout patch should have public land ownership with angling access.**

   Definition: Watershed/patch should have at least some public land (no minimum parcel size) with access for anglers (e.g. State Forests, State Parks, Wildlife Management Areas, County/Municipal Parks, etc).

5. **The brook trout patch should have current land use practices that support continued brook trout persistence.**

   Definition: At least some (no minimum parcel size) private land use practice and/or county zoning exists within the watershed/patch that provide long-term protection of the landscape (e.g. conservation easements, low-density zoning, buffer plantings/maintenance, limited impervious cover, etc). This information was derived primarily from lands enrolled in the Forest Conservation Act, Maryland Environmental Trust, Program Open Space, and Rural Legacy easements.

Criteria Results

Allopatric Patch- There are currently 75 allopatric brook trout patches (67% of all brook trout patches) in Maryland. Most allopatric patches occur in Western Region I, where 76% of all patches have only brook trout present. Western Region II streams contain 10 patches and 50% have only brook trout. The Central Region has 31 patches, 52% of those being allopatric. In wild trout fisheries sympatry was most common with brown trout, followed by rainbow trout.

Density Assessment- Population estimates from 1,372 individual depletion surveys from 1987 to 2019 indicated that the 75th percentile for adult brook trout density is 373 brook trout/kilometer. This 75th percentile estimate will be fixed in time and become the benchmark for meeting this criterion in the future, regardless of future percentile rank. To be considered for the density criterion, a patch has to be sampled a minimum of three occasions, which can occur both spatially and/or temporally. To date, 45 patches have three or more representative samples. Currently, there are 29 patches that have adult brook trout densities at or above 373 fish per kilometer. Sixty-two patches do not have the required three samples and of those, 30 patches are below the threshold. Of the streams not sampled three times, five have the potential to meet the 373 fish per kilometer benchmark and have been prioritized for future field work in upcoming sampling seasons (Table 1). The highest fish densities occur in Middle Fork, a tributary to the Upper Savage River. The greatest densities on average occur in western Maryland. Subsequent monitoring in patches that have not been sampled three times will be based on the likelihood that a patch will meet the 373 fish per kilometer threshold.

Ne Assessment- There are 17 patches that have been assessed for effective population size (Ne). Average Ne for all Level I patches was 167.6. Seven patches have a representative stream with an Ne below the threshold of 50, five are between Ne 50 and 100, and five are above the Ne 100. The highest Ne (595.7) was found in the Upper Savage River patch. Little Antietam was the only Level I patch that did not exceed the minimum Ne 50 (11.6).

Public Land- Assessment of all patches indicated that 87 of 112 (77.7%) have public ownership (Figure 3-5); 90% (9 of 10) of patches in Western region II had public land, followed by 80.6% of the patches in the Central region (25 of 31), and 74.6% of patches in Western region I (54 of 71).

Private Land- Private land conservation programs currently exist on 55 of 112 (49.1%) of all patches statewide (Figure 3-5). The Central region had the most patches with conservation easements at 87.1% (27 of 31), followed by Western II at 80.0% (8 of 10), and Western I at 28.2% (20 of 71).

Chesapeake Bay Agreement – Brook Trout Outcome

Using empirical and anecdotal brook trout occupancy information collected prior to 2014, Hudy (2013b) defined 110 patches of brook trout habitat within the Maryland portion of the Chesapeake Bay watershed, including both allopatric and sympatric populations, totaling 1017 km^2. Of those, 75 patches were considered to be allopatric, totaling 604 km^2. The Brook Trout Outcome under the Vital Habitats Goal of the Chesapeake Bay Agreement calls for an 8% increase in occupied, allopatric brook trout patch area in the Chesapeake Bay watershed by the year 2025. Based on the original assessment by Hudy (2013b), this equates to an increase of 48 km^2 of allopatric brook trout patch area in Maryland and is the amount of allopatric habitat needed to meet the 8% goal established by the Brook Trout Outcome for Maryland.

Since the Chesapeake Bay Agreement was signed, one brook trout population has been restored (Winebrenner Run) in the Maryland portion of the Chesapeake Bay. This project has resulted in 8.2 km^2 of newly occupied allopatric brook trout habitat and represents a 1.6% increase in occupied, allopatric brook trout habitat within the Maryland portion of the Chesapeake Bay watershed. Likewise, this project represents 17% of the total Brook Trout Outcome goal for Maryland. Preliminary post assessment of Aaron Run indicated natural reproduction had occurred. However, increased coal mining operations have occurred in this watershed and the current status of brook trout is unknown.

Brook Trout FMP Work Effort Status

Focus areas for 2021 included:

1) Strategy 4.4. Identify adverse summer water temperature impact areas (impoundments, etc.), and develop strategies to alleviate the impacts;
2) Strategy 8.1. Complete genetic inventory of discrete brook trout populations;
3) Action 9.1. Establish pathways to inform the general public about brook trout conservation and protection; and
4) Strategy 11.1. Develop a consistent, coordinated monitoring program to: 1) assess and track population abundance and viability; 2) monitor and detect environmental changes from anthropogenic (acidification, sedimentation, development/urbanization, AMD, etc.) and natural causes (floods, drought); 3) monitor and detect exotic species encroachment and impacts; and 4) monitor/detect water flow and temperature changes.

Progress was made on all of these focus areas, with the emphasis of efforts being directed towards completing an eDNA project for detecting low abundance brook trout populations in streams where electrofishing surveys may not be possible, completing data collection and reporting for a SWG project that looked at summer flow and temperatures in tributaries to the Upper Savage River, completing an agreement with USFWS to continue genetic monitoring of at risk populations, completing the statewide patch assessment, and establishing a Coldwater Fisheries Advisory Committee (CFAC).

In addition to the aforementioned focus areas, staff also participated in a two day brook trout genetics workshop that was held virtually. Topics of discussion included inbreeding depression in isolated populations, genetic rescue, and effective population size. This information will be considered moving forward for reintroduction and genetic rescue work in Maryland.

A past priority from the 2013/2014 BTFMP review was the development and implementation of a comprehensive statewide sampling schedule, as described in Action 11.1.1 of the FMP (*Action 11.1.1 Develop a monitoring schedule to ensure that all brook trout populations statewide are sampled at least once every 3 years*). The initial sampling effort revealed that a three-year rotation was not feasible, so a five-year rotation (2014 to 2018) schedule was developed and initiated in 2014 and continued through 2018. Following the five year assessment, efforts shifted towards completing the statewide patch assessment. Data gaps discovered during the patch assessment are now driving ongoing brook trout monitoring work. Subsequent five year surveys will likely be on hold until all data gaps are filled and a more comprehensive patch assessment is available.

Current Management and Restoration Efforts

As part of the 2014 Chesapeake Watershed Agreement, brook trout restoration was included as a specific outcome for the Vital Habitats goal. The outcome is to *Restore and sustain naturally reproducing Brook Trout populations in Chesapeake headwater streams, with an eight% increase in occupied habitat by 2025.* The BTP staff worked with the Bay Program's Habitat Goal Implementation Team (GIT) to complete the projects described in the two-year work plan (2020). Staff provided input on the development of the 2020 to 2021 brook trout work plan. The work plan helps guide

restoration to meet the outcome, includes specific research to develop a metric that will track progress towards the goal of increased habitat, and is compatible with the strategies and actions in Maryland's BTFMP. Partners in this effort include MD DNR, New York State Department of Environmental Conservation, Pennsylvania Fish and Boat Commission, Virginia Department of Wildlife Resources, West Virginia Department of Natural Resources, United States Fish and Wildlife Service, United States Geological Survey, Trout Unlimited, and the Eastern Brook Trout Joint Venture.

The BTP staff continued to work with Trout Unlimited representatives, MD DNR Inland Fisheries staff, Carroll and Baltimore County natural resources staff, and local Trout Unlimited chapter members to develop and implement a brook trout restoration effort on a watershed scale for the upper Gunpowder River (UGR) watershed (upstream of the Prettyboy reservoir). This watershed has been identified as having a high likelihood of success for brook trout habitat restoration and reintroduction, and at a larger scale than has been attempted before in Maryland. This is a long-term effort with the potential to provide a significant increase in the amount of habitat occupied by brook trout by 2025.

Staff initiated work for a brook trout habitat connectivity project on Black Lick Run in the USR watershed. Black Lick Run has historically been disconnected from the Savage river mainstream during low flow conditions when fluvial brook trout are in need of thermal refuge. The goal of this project is intended to provide brook trout year round access to a coldwater tributary to the mainstem Savage River that is occasionally isolated during critical low flow/high water temperature periods. The project also includes instream channel work to constrict and increase flow along the lower reach of Black Lick Run to promote fish passage. Efforts to complete this work will continue through 2022.

Experimental brown trout removals were also initiated on Big Hunting Creek and Baisman Run in 2018 with follow up monitoring occurring annually. Preliminary results show brown trout abundance declining, and an increase in brook trout abundance in 2019 and 2020. Monitoring is ongoing as additional years of data will be required to determine if brook trout recruitment has benefited from brown trout removals. Additional concerns remain such as siltation, impervious cover and rising water temperatures. While brown trout are considered an exotic salmonid, they are also managed recreationally and highly valued by trout anglers. Large scale removals are not considered necessary; however, instances on small isolated brook trout populations where barriers exist to prevent future upstream migration from brown trout may be considered on a case by case basis if results indicate benefits to brook trout populations.

Issues of Concern

The loss of brook trout populations statewide determined from our five-year survey is the largest concern facing the future of our statewide population. While not unexpected, these losses reinforce the importance and urgency of protecting our remaining populations. In light of this finding we have initiated work on developing a statewide conservation plan for brook trout that is designed to direct conservation efforts to our most resilient populations, with the intent to insure that these populations will persist long term. Less resilient populations will still be protected through existing regulatory requirements, but the conservation efforts will be focused on maximizing brook trout habitat improvements for the effort and determining funding available to ensure long term persistence of our most viable populations. An additional goal of this plan is to stop the loss of existing populations, then find candidates for reintroduction and increase the number of populations. As such, we have also begun more targeted macroinvertebrate sampling to find coldwater taxa in streams with suitable temperature regimes where habitat conditions have improved and brook trout could potentially recolonize. This effort was initiated in 2019 and will continue over the next 5 to 10 years. Identifying candidate streams for reintroduction will be a top priority for the BTP in 2021 through 2025.

Targeted restoration efforts in our most resilient brook trout watersheds will be a focus in 2021 and beyond. Land cover assessments and identification of property owners for stream restoration and riparian buffer plantings is the most cost effective strategy for increasing brook trout populations, reducing stream temperatures, and connecting isolated populations. We will work with our partners to identify cost share programs available to landowners to implement restoration efforts on a larger scale and track progress towards reducing unforested land in brook trout watersheds.

Additional issues of concern for Maryland brook trout conservation include determining angling effort and harvest, climate change impacts, continued pressure from land development in brook trout watersheds, and energy extraction and development issues (gas and wind). Angler and citizen input and volunteer effort will be vital for brook trout conservation, as land use and development issues are the determining factors for habitat loss and continued brook trout survival. Participating in citizen watershed associations and angler advocacy groups can provide valuable and needed input to assist municipalities and counties with brook trout conservation. The Maryland Brook Trout webpage lists sites and names of state and national groups that are working for brook trout conservation.
https://dnr.maryland.gov/fisheries/pages/brook-trout/index.aspx

Table 1. 2014-2018 statewide brook trout sampling effort by river basin, as per the Maryland Department of Natural Resources Brook Trout Fisheries Management Plan.

River Basin	# Streams Sampled 2014	# Streams Sampled 2015	# Streams Sampled 2016	# Streams Sampled 2017	# Streams Sampled 2018
GU	5	19	20	26	8
PA	10	-	2	2	-
MP	3	3	6	22	2
UNB	24	24	44	62	70
UP	2	-	2	-	-
WC	1	-	1	1	-
YG	26	31	12	7	10

GU = Gunpowder River; PA = Patapsco River; MP = Middle Potomac River; UNB = Upper North Branch Potomac River; UP = Upper Potomac River; WC = West Chesapeake Bay; YG = Youghiogheny River

Table 2. Summary of brook trout occupancy information at the catchment scale for data collected during the period 2014 through 2018, statewide and by region.

Region	# of Catchments Sampled	# of Catchments Occupied	% of Catchments Occupied	% Change in Occupancy (+/-)
Statewide	440	317	73.0	-27.0
Western I	256	216	85.1	-14.9
Western II	33	26	78.8	-21.2
Central	151	75	50.7	-49.3

Figure 1. Historic Distribution of Brook Trout in Maryland, by subwatersheds (green is historically occupied).

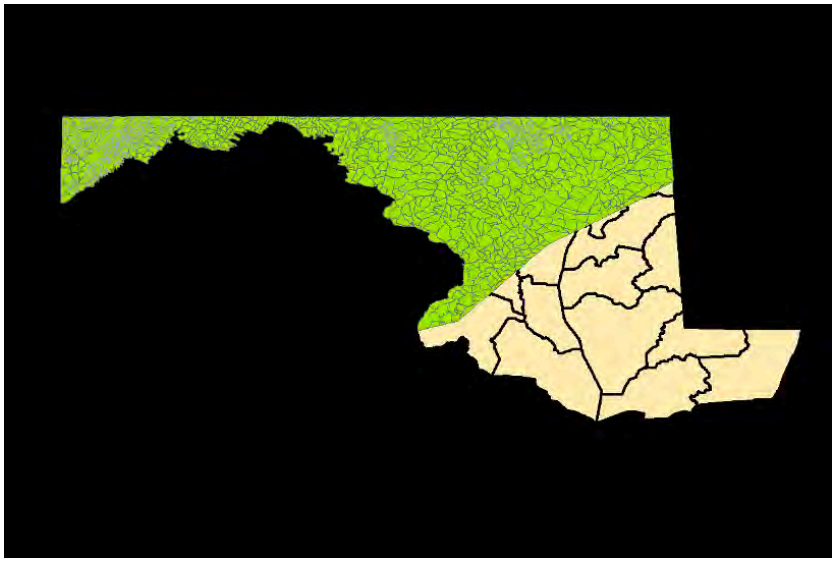
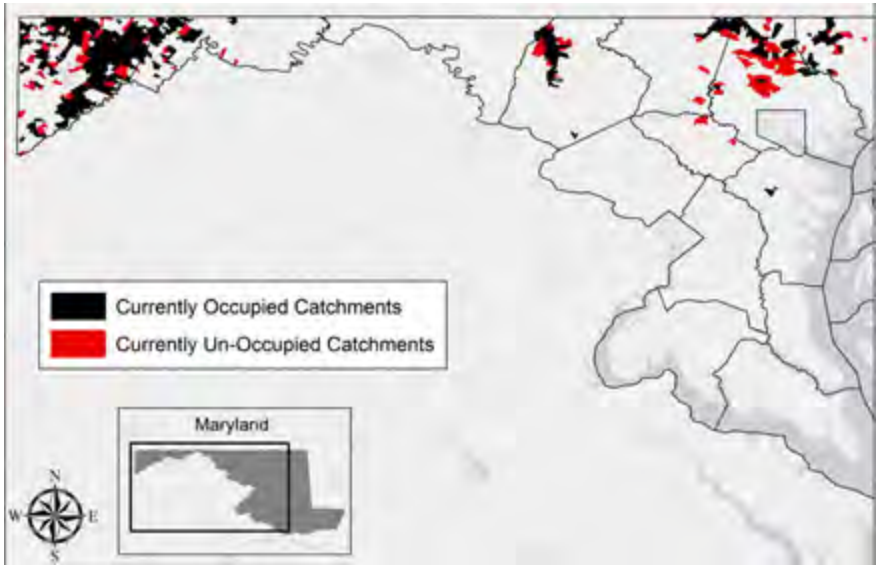


Figure 2. Current (2018) Distribution of Brook Trout in Maryland, by subwatersheds (black is currently occupied).



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Maryland Brook Trout Fisheries Management Plan Implementation Table.

Strategy	Action	Date	Comments
Strategy 1.1 Investigate the life history characteristics, i.e. mortality, longevity, fecundity, growth rate, of Maryland brook trout populations statewide.	Action 1.1.1 Identify and pursue additional funding sources to accomplish the needed work.	2009 - 2013 Completed	Joint research project with the UMCES Appalachian Laboratory (AL) and MD DNR Fisheries. Funds included a SWG grant. Initiated study of brook trout life history study in the Savage River. This was the number 1 priority action in 2010. Final reports completed including a doctoral thesis supported by this research.
Strategy 1.2 Investigate angler use and exploitation on Maryland brook trout populations statewide, through creel surveys and harvest and incidental angling mortality related to brook trout length, frequency, structure, and maximum fish size.	Action 1.2.1 Identify and pursue additional funding sources to accomplish the needed work.	2012-2013 As Needed	Focus area for 2018-2020 Upper Savage River creel survey completed. Statewide creel survey will be based on the Upper Savage River creel survey. Funding necessary to expand survey statewide has not been identified.
Strategy 2.1 Develop a GEP index for brook trout populations in the state of Maryland.	Action 2.1.1 Submit a proposal for funding a GEP index research project to the Maryland DNR State Wildlife Grant program for FY07.	2007-2009 Completed	A SWG project report was completed in 2009. Report directs watershed associations and regional managers where to target conservation efforts.
Strategy 2.2 Utilize the index to categorize the status of brook trout populations in Maryland, and create a priority list of those most at risk, and those for which conservation efforts would have long term potential for long term restoration.	Action 2.1.1 Conduct statewide patch assessment to evaluate resiliency of all occupied patches.	2009 Initiated in 2019 Completed initial assessment in 2020	No action was formulated in the BTFMP. GEP index and report (Action 2.1.1) will be used to identify populations at risk by watershed and guide conservation efforts. Priority list will be developed during 2019 – 2020 in conjunction with results from the 5-year statewide survey. Preliminary results indicate 10 patches meet 4 of 5 rating criteria. The final report was completed in 2020. The 2020 patch assessment identified 10 patches that met at least ⅘ criteria and are considered our most resilient brook trout strongholds in the the state. These patches have been outlined and identified in the Coldwater Resources Mapping tool https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=dc5100c0266d4ce89df813f34678944a.

			Data gaps for the remaining patches have been identified through the patch assessment and are being prioritized for future monitoring work. Nine streams were sampled in 2020 to collect fin clips from at least 50 trout to allow for genetic analysis and determine effective population size for these patches. This will help us gather all the needed data to eventually conduct a complete patch assessment. In the meantime, habitat and restoration work will be emphasized to occur in our 10 strongholds.
Strategy 3.1 Identify and protect at- risk brook trout populations.	Action 3.1.1 Determine at- risk populations by statewide fisheries region using current data, and then by using GEP index information once it becomes available.	In progress, the ongoing development of a statewide conservation plan will incorporate this concept	Developing a GIS layer to identify and prioritize at-risk populations, based on GEP and other risk factors. Additional resources are needed to continue project. Will incorporate results of the 5-year statewide survey.
	Action 3.1.2 Develop a priority list of populations to be protected, incorporating the GEP index value, land ownership (private versus public), upstream watershed size and land use, public resource access, connectivity to other brook trout populations, and recreational value.	Pending	Requires completion of 3.1.1. The priority list will be generated when the GEP map has been developed. This was partially achieved through the initial patch assessment. Patches were rated based on public land ownership and private land conservation programs. Land use within the 50 m stream buffer of all trout watersheds has been quantified and is available on the coldwater resources mapping tool.
Strategy 4.1 Develop a brook trout management plan for the Savage River watershed upstream of the Savage River dam. This plan will be used as a blueprint for developing plans in other brook trout watersheds.	Action 4.1.1 Develop a comprehensive Geographic Information System (GIS) database detailing land ownership and usage within the upper Savage River watershed, incorporating summer water temperatures and brook trout population abundance from the Maryland DNR's Inland Fisheries and MBSS databases.	2007 Continue	The GIS project was incorporated into a comprehensive, statewide geodatabase and made available through the online "Coldwater Resources Mapping Tool" that accomplishes the same objectives. Using the database and a statewide monitoring effort, a brook trout conservation strategy was developed in 2020 and will be used to direct statewide brook trout conservation efforts. These actions expanded the individual plan for the USR to statewide efforts and are currently being implemented.
	Action 4.1.2 Utilizing the GIS analysis, identify areas within the USR watershed that are impacting brook trout populations and water quality, and develop a priority list of restoration/conservation activities.	2007 Continue	Requires completion of 4.1.1. Final report is being drafted. Report will include a prioritized list of impacted brook trout populations. Spatial analysis was conducted on all brook trout streams in Maryland by delineating 2013-2014 NLDS land cover within 50 m buffers of all brook trout streams, including the Savage River Watershed. This data is also spatially overlaid with tax parcel ID layers. All this information is available on the Coldwater Resources Mapping Tool. Users can zoom

			into brook trout streams and identify areas of stream that are unforested and who the property owners are.
	Action 4.1.3 Identify areas within the Savage River that need additional conservation.	2007 Continue	See Action 4.1.1. Specific areas within stronghold watersheds (including the Savage River Watershed) have been identified for conservation efforts.
Strategy 4.2 Present the information and recommendations in the BTFMP to the MD DNR Western Regional Team to solicit input and support.		2007 Discontinued	No action was formulated in the BTFMP. The MD DNR Western Regional team was disbanded in 2007. Strategy is no longer practicable and is not being pursued.
Strategy 4.3 Develop a watershed-wide strategy for protecting habitat, especially buffer protection and restoration in impacted headwater streams.		This is being done as part of the development of the statewide conservation plan 2020	No action was formulated in the BTFMP. Action: Create a stream buffer and land use/land cover map to locate areas of concern. Threshold for negative impacts is 2% impervious surface. The map will incorporate existing state and federal land preservation and buffer strip restoration programs. Brook trout streams statewide, including the Savage River Watershed, were evaluated for land cover types within the 50 m riparian buffer. This information is available on the Coldwater Resources Mapping Tool. Complete land cover summaries within the watershed and the 50 m riparian buffer are also included in the appendix of the Statewide Brook Trout Patch Assessment.
Strategy 4.4 Identify adverse summer water temperature impact areas (impoundments, etc.), and develop strategies to alleviate the impacts.	Action 4.5.1 Conduct summer temperature and flow monitoring in mainstem Savage River and seven tributaries.	2007 Continue	No action was formulated in the BTFMP. Action: Create a network of temperature loggers to monitor thermal impacts to streams. Focus area for 2018-2020 Obtain existing water temperature data and develop a GIS layer within the brook trout database. Continue to collect new data statewide. Field work and data collection was completed in 2020. Temperature and flow measurements from seven tributaries were compared to the Savage mainstem gauge at Barton to determine percent contribution of flow, and which tributaries were supplying the most cold water during summer months (i.e. July and August). Assessment indicates that the Little Savage River and Poplar Lick supply the majority of cold water to the Savage mainstem during the summer, while Mudlick appears to be a heat source. In addition, withdrawal data was obtained from MDE as reported by the city of Frostburg at the Savage Springs location near I-68. Analysis indicates that water withdrawals can exceed the amount

			of flow in the mainstem during low flow years. This has the potential to greatly increase the amount of cold water available to the mainstem through negotiated withdrawal permitting. A final report is available. While the city of Frostburg is not interested in changing their withdrawal strategy at this time, efforts will continue to collect data in the watershed and consider alternative options that would improve groundwater availability.
Strategy 4.5 Designates the upper Savage River watershed a fisheries "Habitat Area of Particular Concern" (HAPC). This designation will allow the development of regulations and monitoring programs to protect the resource on a watershed specific basis. It will also help to develop and foster the public and resource users' support for the management actions that need to occur; it will focus efforts to accomplish necessary research, and it will demonstrate Maryland's commitment to protecting and conserving this unique resource.	Action 4.5.1 Institute angling regulations to provide for maximum protection of brook trout while still ensuring angler use of the resource, i.e. no closed season, no harvest, single hook barbless lures only, no bait.	2007 2007 – 2013 Continue	State fishery regulation was enacted to protect upper Savage River brook trout: COMAR 08.02.11.01. Annual monitoring of trout population response is ongoing through at least 2020. Results indicate that the regulation has been effective in meeting management objectives to increase the number of fish >200 mm, reduce angler related mortality, and protect the only intact brook trout system in MD (upper Savage River), while optimizing angling use. Restoration of trout population densities has been partially successful. Plans for long term continued monitoring will be developed in winter 2014, and implemented in summer 2015.
Strategy 4.6 Promote and encourage the development of a citizen-based Savage River watershed advocacy organization. MD DNR will provide technical support as needed.		2006 Completed	No action was formulated in the BTFMP. Savage River Watershed Association (SRWA) formed and has partnered with MD DNR in protecting and restoring the watershed. SRWA framework is being used as a model for other watershed associations. Watershed associations will assist with FMP action implementation.
Strategy 5.1 Encourage riparian buffer habitat preservation and restoration.	Action 5.1.1 Develop a list of target watersheds in Maryland that could benefit from the CREP program, rank each system based on brook trout population status	Pending	Implementation requires completion of Strategy 4.3. Implementation will aid with at-risk population targeting.

	(best to worst), headwater agricultural impact, and size and connectedness of the system.		
	Action 5.1.2 Using the list generated from Action 5.1.1, actively recruit and enroll farmers from the targeted watersheds into the CREP program.	Pending	Dependent on the completion of Action 5.1.1
	Action 5.1.3 Create a list of the Federal, state, and NGO conservation and restoration programs that are available to landowners; inform Regional Fisheries managers and biologists of these programs so they can work with private landowners to improve land use and water quality.	Pending	No progress to date. Work with landowners, counties, NRCS, and Maryland Forest Service is planned for FY 22 to sign landowners up for buffer planting programs in targeted brook trout watersheds.
Strategy 6.1 The information that is needed by regulators and developers to appropriately consider and plan activities so they do not adversely impact brook trout populations is available. Developing an outreach strategy to convey this information will provide key agencies and developers with the understanding necessary to make appropriate decisions.	Action 6.1.1 Develop a series of PowerPoint presentations that illustrate the life history needs of brook trout, and the adverse impacts that can occur from anthropogenic activities. Provide an ecosystem perspective by including a description of how brook trout serve as indicators of overall stream health, and what a healthy brook trout population means to the health of a watershed and the lives of those who reside there.	2011 Completed 2011 Continue	Eastern Brook Trout Joint Venture (EBTJV) developed educational and outreach materials such as videos, webinars, maps, and reports with a national perspective. More information is available at http://easternbrooktrout.org/ Information from brook trout research and similar efforts is now available to fully develop communication and education tools for protection of brook trout and their habitat in MD. Action 6.1.1 is scheduled for completion in 2016 – 2017. A coldwater presentation has been developed that includes a brook trout component. This will be presented to relevant parties as opportunities exist and will be used in conjunction with the developing conservation plan.
	Action 6.1.2 Meet with county and local government officials/agencies and commercial developers to present the information and to establish a dialog on the issues relating to the conservation and value of Maryland's native brook trout.	Continue through 2021	Requires completion of 6.1.1. This is ongoing. Contact was initiated in 2019 to introduce the conservation plan framework. Followup communication in 2020 including dissemination of the final Patch assessment, work with MDE on temperature TMDL development and thermal issues related to pond effluent from private and stormwater management facilities.
	Action 6.1.3 Make presentations available to the general public through appropriate pathways, i.e. websites, libraries, etc.	Continue through 2021.	Requires completion of 6.1.1.

	Action 6.1.4 Work cooperatively with other state agencies to ensure adherence to state water quality standards.	2007 Continue	Better communication fostered between MDE and MD DNR. MD DNR environmental review expanded to include teams that address specific water quality issues. Direct negotiations between Inland Fisheries and MDE focused primarily on stream classification. and MDE focused primarily on stream classification. Currently working to improve the thermal review process with MDE and helping develop thermal TMDL guidelines to enforce Use III standards.
Strategy 7.1 Develop statewide restoration guidelines for restoring extirpated brook trout populations.	Action 7.1.1 Adopt and modify the guidelines developed for brook trout restoration by the American Fisheries Society's Southern Division Trout Committee.	Pending	Focus area for 2018-2020. Continue to participate in what is now a multi-state/agency effort to develop these guidelines, with a timeline of completion in 2022 to 2023. Implementation is pending information from the life history and genetic research projects (Actions 1.1.1 and 7.1.2) and review of the Southern Division of the American Fisheries Society Technical Committee's (SDAFS TC) guidelines for brook trout restoration. Work was originally scheduled for 2015 – 2016 but rescheduled for 2022.
	Action 7.1.2 Incorporate a genetic component into the guidelines to direct brood fish selection location.	2010 - 2013 2014 Continue	UMCES Appalachian Lab has collected and inventoried brook trout genetics in all watersheds. Laboratory work and analysis will continue through 2022. Should have guidelines established by 2022, following genetics workshops and reintroduction trials.
Strategy 8.1 Complete genetic inventory of discrete brook trout populations.	Action 8.1 Secure funding (an estimated $10,000) to complete the statewide brook trout genetic inventory. The USFWS State Wildlife Grant Program and EBTJV are two possible funding sources for completing this work.	Pending	Funds are being sought to complete the genetic inventory. Partially completed for the USR in 2014, SWG funding secured in 2016, samples will be collected in 2017, and a report generated in 2018-2019. Genetic Structure of Maryland Brook Trout Populations: Management Implications for a Threatened Species was published by Morgan et al. 2021. An agreement was made with USFWS Northeast Fisheries Science Center in Lamar, PA to analyze finclips collected from selected streams in Maryland. Fin clip collections occurred in 2020 and 2021 with additional collections scheduled in 2022 in targeted streams to complete the statewide patch assessment. Samples from eight streams were submitted in 2021, with an additional 12 to be sent in 2022. A report will be submitted for data collected through 2022.
Strategy 9.1 Establish pathways to inform the general public about brook trout conservation and protection.	Action 9.1.1 Utilize the Maryland Sport Fisheries Advisory Commission (SFAC), MD DNR Regional Teams, and other appropriate state agencies to solicit input on brook trout conservation measures.	Continue	Focus area for 2018-2020 Strategy 9.1 aligns with Strategy 6.1. Inland Fisheries advises the MD Taskforce on Fisheries Management and regularly updates the SFAC as new research, monitoring, and regulation information becomes available.

			Presented a draft conservation framework to SFAC for approval. Proposed and adopted catch and release regulations for brook trout in all put and take waters and all waters east of I-81. This regulation went through two public scoping periods and received overwhelming support. More than 400 comments were submitted by anglers of which over 95% supported the regulation. The regulation took effect January 1, 2021. As requested by SFAC, Freshwater Fisheries assembled a Coldwater Fisheries Advisory Committee (CFAC) to facilitate communication and provide guidance on brook trout management and conservation efforts. The first meeting of the committee is in 2022.
	Action 9.1.2 Post the BTFMP on the MD DNR Fishing and Boating Services webpage and request on-line comments on conservation measures as part of the regular review of the BTFMP.	2006 Continue Completed	Strategy 9.1 aligns with Strategy 6.1. BTFMP posted on line. Trout fishing information is available on the MD DNR Fishing and Boating Services website. A MD DNR Brook Trout webpage has been completed, and provides program information such as management updates, research highlights, and habitat needs. The webpage includes an interactive public comment interface, allowing MD DNR to solicit public input, opinions, and observations regarding current and proposed conservation and management actions.
Strategy 10.1 Encourage public participation in fishery management through informational and regulatory meetings, and the development of organized watershed advocacy groups. Current federal efforts are directed at assisting the formation of advocacy groups by funding startup and operational costs.	Action 10.1 Develop a list of watershed advocacy organizations in Maryland with current contact information. Evaluate the need for additional groups. Create a list of federal agency contacts that can assist with citizen advocacy groups.	2009 Completed	A list of watershed groups and advocacy organizations has been created. These organizations have developed their own lists of federal agency contacts.
Strategy 11.1 Develop a consistent, coordinated monitoring program to: 1) assess and track population abundance and viability; 2) monitor and detect	Action 11.1.1 Develop a monitoring schedule to ensure that all brook trout populations statewide are sampled at least once every 3 years.	2008-2009 Completed 2009 First 5-year cycle Completed in 2018.	Monitoring plan is a Federal Aid requirement. Comments from the MD Task Force on Fisheries Management and SFAC were incorporated in the plan. Focus area for 2017-2020 Streams will be monitored on a five-year rotation from 2014- 2018.

environmental changes from anthropogenic (acidification, sedimentation, development/ urbanization, AMD, etc.) and natural causes (floods, drought); 3) monitor and detect exotic species encroachment and impacts; and 4) monitor/detect water flow and temperature changes.		Continue on a 5-year sampling rotation. Starting date for the next cycle will be determined following implementation of statewide conservation plan.	Brook trout in the upper Savage River were tagged and tracked via radio telemetry. Seasonal distribution was documented and tributary connectivity will be important for effective population management. A manuscript was drafted, and study results are not yet available pending publication. Report completed and published as a peer reviewed article.
	Action 11.1.2 Coordinate brook trout sampling efforts between Inland Fisheries and the MBSS to maximize efficiency. Where possible, reduce the number of sites Inland Fisheries needs to monitor. Fisheries should focus on monitoring streams for recreational fisheries, MBSS on sampling headwater, privately owned streams.	Began 2006 Formalized 2010 This action is now done annually to coordinate sampling	Freshwater Fisheries and MBSS have increased sampling coordination. Action will continue annually. Identified watersheds for targeted sampling to fill in data gaps for patch assessment. Future monitoring will be more tactical in conjunction with routine monitoring. In 2021, methods that use eDNA to determine brook trout presence/absence were investigated to determine if they are a feasible option to improve survey efficiency and provide an alternative method for streams with limited access. Investigations will continue through 2022 and a final report will be made available.
Strategy 12.1 Develop a standardized sampling protocol for monitoring brook trout populations that includes: MBSS water quality and habitat data collection components, establishment of permanent sampling stations, number of stations per stream length, and fish collection methodology.	Action 12.1.1 Create a sampling standardization committee with members from Inland Fisheries and MBSS to develop the sampling methodology.	2006 2011 Pending	MBSS sampling protocol informally adopted for portions of the Savage River. MBSS sampling protocol requires more discussion before being implemented statewide. Integration of a multi-layer sampling protocol is being considered as a modification to the MBSS sampling protocol.
	Action 12.1.2 Conduct training with Inland Fisheries staff to implement the standardized methodology.	2011	Completion of Action 12.1.1 is required. Some informal training has been done to date.
	Action 12.1.3 Collect summer water temperatures with in-stream temperature.	2007 Continue	Strategy 12.1 aligns with Strategy 4.4. Includes Inland Fisheries efforts and data from MBSS.
Strategy 13.1 Develop a database that incorporates, and where possible, standardizes, the historic and current statewide brook trout information available from the Inland Fisheries, the MBSS, and the University of Maryland monitoring programs.	Action 13.1.1 Establish a data management group that includes a representative from each of the major groups (MD DNR, UM, and MBSS) to standardize the data collection format and create a statewide database of brook trout information.	2009 Completed Updates ongoing	Informal data management group has been established and convenes as needed. The Coldwater database was completed in 2019 and includes all wild trout and brook trout records from MBSS and Freshwater Fisheries. This database is updated annually with the most recent monitoring records. Brook trout collection methods are standardized by both the MBSS SOP and Freshwater Fisheries wadeable streams SOP.

	Action 13.1.2 Identify other sources of brook trout data, such as MD Bureau of Mines, additional academic institutions, and Federal agencies, and incorporate the data into the statewide format.	Completed	Completed in conjunction with Action 13.1.1.
	Action 13.1.3 Develop a GIS database describing BT population boundaries, population information, habitat variable information, and water temperature data.	2009 Continue	GIS database was completed and functional in 2013. It will be updated annually. Continuing to work with regional fisheries staff to collate data and update the Coldwater Resources Mapping Tool.

Acronyms

AMD – Acid Mine Drainage
BTFMP – Brook Trout Fisheries Management Plan
CBT – Chesapeake Bay Trust
COMAR – Code of Maryland Regulations
CREP – Conservation Reserve Enhancement Program
CVI – Canaan Valley Institute
EBTJV – Eastern Brook Trout Joint Venture
FY – Fiscal Year
GEP – Genetic Effective Population
GIS – Geographic Information System
GMR – General Management Recommendations
LWD – Large Woody Debris
MBSS – Maryland Biological Stream Survey
MD – Maryland
MD DNR – Maryland Department of Natural Resources
MDE – Maryland Department of the Environment
NFWF – National Fish and Wildlife Foundation
NLDS – National Landcover Dataset
NRCS – National Resources Conservation Service
SDAFS – Southern Division of the American Fisheries Society
SOP – Standard Operating Procedure
SFAC – Sport Fisheries Advisory Commission
SRWA – Savage River Watershed Association
SWG – State Wildlife Grant
TC – Technical Committee
TMDL – Total Maximum Daily Load
TU – Trout Unlimited
UGR – Upper Gunpowder River
UMCES – University of Maryland Center for Environmental Science
USGS – United States Geological Survey
USFWS – United States Fish and Wildlife Service
USR – Upper Savage River Watershed

2021 Maryland FMP Report (December 2022)
Section 24. Largemouth bass (*Micropterus salmoides*) in Maryland Tidewater

The Black Bass Advisory Committee (BBAC) was formed in 2016 to address management issues for the recovery of black bass in the Upper Bay and Potomac River. Prior to the new committee, the Maryland Department of Natural Resources, Fishing and Boating Services, (MD DNR, FABS) hosted informal meetings as needed to discuss black bass issues. The BBAC met five times in 2021. Members have discussed a range of topics and have presented information to the SFAC for consideration. The discussions have focused on developing new regulations for black bass during the spawning season and new education platforms for anglers. Members recommended a study on haul seine impacts on nesting largemouth bass, discussed problems with enforcing current regulations and changing spring regulations, and promoting catch-photo-release style tournaments during warm summer months when largemouth bass most often die due to handling stress. No new regulations have been proposed or scoped as a result of these discussions. However, a Freshwater Bass Conservation Fund was discussed during the meetings and is currently being considered by the department and General Assembly for adoption in 2023. Other discussion topics and subsequent actions can be found on the BBAC webpage. http://dnr.maryland.gov/fisheries/Pages/mgmt-committees/bbas-index.aspx

To improve ways of delivering conservation education to anglers, a Black Bass Conservation Award and online Bass Class were developed for 2017. A new Bass Conservation webpage was created and includes a video about live well maintenance during bass tournaments. https://dnr.maryland.gov/fisheries/pages/conserve-bass.aspx.

Largemouth bass have been widely introduced throughout the United States, from beyond their initial Mississippi River drainage distribution. As populations thrived, commercial and recreational fisheries developed. Commercial sale of largemouth bass is now illegal in Maryland, and the recreational fishery includes pass-time fishing, live-release competitive sportfishing (i.e., tournaments), and charter boat guiding. Fishing pressure is an important consideration for the largemouth bass fishery, even though it is primarily a catch-and-release fishery. Harvest, catch-and-release mortality, and a daily possession of bass during tournaments can affect survival of adults and contribute to fishing mortality. Aside from fishing mortality, natural mortality and reproduction are affected by habitat quality. Habitat conditions may be influenced by pollution, invasive species, and climate change. Because of the roles of both fishing pressure and habitat quality on structuring largemouth bass populations, strategies and actions in its fishery management plan were developed to manage largemouth bass in Maryland's tidal waters.

Fishery Management Plan (FMP)

Strategies and management actions are described in the Fishery Management Plan for Largemouth Bass in Maryland Tidewater (January 2014) (MDLB FMP). The goal of the MDLB FMP is to describe objective reference points and provide management targets for populations in tidal freshwater habitats of the Maryland portion of the Chesapeake Bay watershed. Largemouth bass populations occur throughout Maryland's tidal freshwater. Populations differ in size, size structure, and productivity because of differing habitat quality and fishing pressure. In some locations, it has become necessary to implement management actions to help conserve the population by minimizing the negative impacts of intense fishing pressure and poor habitat quality. Actions have also been taken to identify 'at risk' populations so that resources may be effectively appropriated. At-risk populations are identified using a suite of indices calculated, in part, from surveys described in the Standard Operating Procedure (SOP) for the Tidal Bass Program (TBP). Other indices are calculated from tournament reporting. The methodology within the SOP has undergone external peer-review for at least three cases, and results are reported annually within the Federal Aid Report (for federal and technical audiences) and Black Bass Annual Review (for the general public). The MDLB FMP, SOP, short reports, and fishery related data are posted on the TBP website: https://dnr.maryland.gov/fisheries/pages/bass/index.aspx

Stock Status

Stock status for largemouth bass in 2021 was determined using survey data from fishery independent and dependent surveys. Assessments were conducted for each riverine population, indices were compared with reference points (Table 1), and general conclusions were drawn based upon the suite of indices and their relationships to reference points.

Potomac River – Status Good

Staff caught 657 largemouth bass, including 547 juveniles. Catch was average owed to good reproduction but fewer than expected age 1 and older bass were collected. Sections of river near the Woodrow Wilson Bridge had less submerged aquatic vegetation (an important habitat for young fish) than in the past, which could help explain less recruitment (i.e., growth to adulthood). Tournament anglers reportedly caught three to four bass per fishing day, which was within management targets for the fishery. Reproduction was above average, which should result in more older fish in coming years. Body growth was also above average and bass generally exhibited good body condition. Of all caught bass, eleven showed signs of mild to moderate disease; seven from Mattawoman Creek; two from Piscataway Creek; two from Chicamuxen Creek. Because of average catch and above average reproduction and growth, the status of this fishery was designated as *Good*.

Upper Bay – Status Good
We caught 207 largemouth bass, including 137 juveniles. Catch was average relative to previous years, though there were fewer than normal age one and older fish. Tournament anglers reported catching two bass per fishing day, which is similar to previous years. Reproduction has been good over recent years and should result in more older fish in coming years. Young fish (ages 1-3) exhibited good growth and adults, on average, had good body condition. Annual mortality was slightly higher than average, but not alarming. Of all caught bass, eight had signs of mild to moderate disease; four from Northeast River, two from Furnace Bay, one from the lower Susquehanna River, and one from Swan Creek. Because of average catch indices and generally good growth, the status of this fishery was designated as *Good*.

Gunpowder River – Status Unknown
Staff caught 37 largemouth bass, including 18 juveniles. Catch has not changed in the past three years after greatly increasing over levels observed between 2013 and 2017. While bass showed average reproduction, recruitment appears limited because fewer than expected subadult bass (8 inches to 12 inches) were collected. No largemouth bass had signs of disease and instead, generally had good body condition. Because of the limited dataset for comparison, the status of this fishery has been designated as *Unknown*.

Middle River – Status Unknown
Staff caught nine largemouth bass, including two juveniles. Catch has been similar since 2018. The average index of juvenile abundance was the lowest among tidal populations of bass surveyed in 2021 and were collected at only 29% of sites. Average body growth rate was low relative to that for other tidal populations of bass, but body condition or robustness was good. None of the nine collected bass had signs of disease. Because of the limited dataset for comparison, the status of this fishery has been designated as *Unknown*.

Bush River – Status Unknown
Staff caught 18 largemouth bass, including one juvenile. Catch has been similar since 2018. The average index for juvenile catch was similar to nearby Gunpowder River, but proportionately fewer sites had juveniles and reproduction was poorer than in previous years. One largemouth bass had signs of minimal disease. Average growth and body condition were similar to those for the nearby Gunpowder River. Because of the limited dataset for comparison, the status of this fishery has been designated as *Unknown*.

Choptank River – Status Good
We caught 68 largemouth bass, including 17 juveniles. Catch was average and juveniles relative to the time series for the population. Fish exhibited above average growth and average body condition, with only one showing signs of mild disease. Because of average catch and reproduction, the status of this fishery was designated as *Good*.

Chester River – Status Good
We caught 116 largemouth bass, including 26 juveniles. Catch was above average and juveniles were collected at a greater percentage of sites than normal. Growth was above average for the population. Bass generally exhibited good body condition. Ten bass showed signs of mild disease; eight of these were caught near Millington and two were caught downstream of Highway 301. Because of above average catch and growth, and average catch of age 1+ fish and juveniles, the status of this fishery was designated as *Good*.

Current Management Measures/The Fishery

The number of largemouth bass caught, weighed, and released by tournament anglers is reported by permitted tournament directors. Not all tournaments are permitted, particularly those without a staged weigh-in area, or those with less than 10 boats. There are no protocols in place to measure the number of largemouth bass caught and released by pass-time anglers or charter boat guide clients. A creel survey was conducted in May 2017 to measure fishing effort in tidal waters of the Potomac River and upper Chesapeake Bay. These data will improve MD DNR's ability to objectively assess the quality of the fishery from the angler perspective.

Four jurisdictions manage the largemouth bass fishery on tidal waters of Potomac River. The jurisdictions include: Potomac River Fisheries Commission (PRFC), Virginia Department of Wildlife Resources (DWR), District Department of Energy and Environment (DOEE), and MD DNR. Because anglers commonly fish across jurisdictional boundaries and fish are intermixed among the jurisdictions, any regulatory changes or conservation concerns identified by any one jurisdiction can affect them all. For that reason, a joint cooperative management strategy was developed in 2019 and implemented in 2021. More details on this cooperative management strategy can be found online:
https://dnr.maryland.gov/fisheries/Documents/BBAR.pdf

There is a minimum size limit of 12 inches for largemouth bass between June 16 and the end of February (inclusive) in tidewater. This minimum size limit essentially prevents smaller or younger fish from being harvested (~ 1% of anglers), or from being moved around and experiencing handling stress during competitive sportfishing tournaments. Currently, there are no reliable statistics that indicate the proportion of tournament anglers within the bass fishery. Nonetheless, tournament anglers are considered a large, important group of anglers within the tidewater fishery. There is a 15 inches minimum size limit for largemouth bass between March 1 and June 15 (inclusive) in tidewater. The larger size limit was implemented in 1989

to reduce the number of sexually mature largemouth bass moved from their nests to a weigh-in station during the spawning season. These size limits do not prevent catch-and-release fishing which can be harmful during the spawning season and can also lead to mortality from excessive handling.

Focus Areas for 2021-2022

The TBP will focus on the following actions:

1) Continue the Tidal Bass Survey so that at least a 10-year baseline of data is established for targeted tidewater areas, including Bush River, Middle River, and Gunpowder River, and populations are monitored at least bi-annually. Expand the survey to the Chester River and Sassafras River. Continue surveys as specified in the Tidal Bass Program's Standard Operating Procedure during fall, as funded with federal and state money. https://dnr.maryland.gov/fisheries/Documents/Tidal_Bass_Survey_SOP.pdf
2) Continue efforts aimed at supporting reproduction and recruitment, as well as conservation actions aimed at adults, in the Potomac River and upper Chesapeake Bay, where abundance of age1+ has lagged.
3) Continue efforts to rebuild the fishery in Gunpowder River by stocking.
4) Support Potomac River Interjurisdictional Cooperative Management for the largemouth bass fishery with a creel survey and continued tagging.
5) Widely encourage use of the Volunteer Angler Survey for Multi-species Freshwater Fishes.
6) Support responsible growth of bass tournaments at Conowingo Reservoir, Elk Neck State Park, Leesylvania State Park, and other popular fishing access areas.
7) Improve data collection and reporting efficiency between electronic datasheet collection, data upload to GIFS, and data export for user groups.

Table 1. Stock assessment of largemouth bass populations in 2021 for targeted drainages of the Chesapeake Bay watershed using indices and metrics reflecting changes in population biology. When a metric falls below the 25th percentile computed for available data for that river, the ↓ symbol is given. When a metric falls above the 75th percentile computed for available data for that river, then the ↑ symbol is given. Abbreviations for indices are at the bottom of the table. NA = Not Available

River	N	CPUE	CPUE, 1+	PSD_{305}	PSD_{381}	A (-Z)	GR-EXPrise	GR-VBGF	LW-Slope	W_r	K_n	JuvCPUE	JUVPSD	JUV%OCC
Upper Bay	31	52.71	15.18↓	0.56↓	0.29↓	0.45 (-0.59)↑	73.18↑	73.46↑	3.11↓	1.00	1.00	38.31	0.66↑	0.78
Potomac	52	70.23	11.95↓	0.78	0.45↑	0.49 (-0.67)	68.24↑	68.49↑	3.17	1.01	1.00	75.98↑	0.83↑	0.85↑
Chester	22	43.97↑	44.13	0.81	0.24↓	NA	71.54↑	71.82↑	3.24↑	1.00	1.00	12.61	0.22↑	0.73↑
Choptank	35	17.86	14.41	0.67	0.25↓	0.47 (-0.63)↑	72.41↑	72.66↑	3.13↓	1.00	1.00	14.89	0.25	0.29
Gunpowder	15	24.41	12.86	1.00	0.47	NA	60.25	60.50	3.34	1.01	0.99	14.60	0.49	0.67
Middle	7	12.41	9.78	0.29	0.29	NA	57.48	57.55	3.40	1.00	1.00	9.21	0.22	0.29
Bush	10	20.20	18.89	0.94	0.61	NA	63.39	63.63	2.96	1.01	1.00	13.04	0.06	0.10

Patuxent River, Choptank River, and Wicomico River were not sampled in 2019.

Table Acronyms

N – Number of sites surveyed
CPUE – Catch per unit effort
CPUE, +1 – Catch per unit effort for age 1 and older fish
PSD_{305} – Proportional size distribution for stock size fish that were 305 mm or greater
PSD_{381} – Proportional size distribution for stock size fish that were 381 mm or greater
Z – Total annual mortality
$GR_{EXPrise}$ – Growth rate determined from a two-parameter, isometric growth model
GR_{VBGF} – Growth rate for von Bertalanffy growth models
LW-slope – the slope of the length-weight regression
W_r – relative weight
K_n – relative body condition
JUVCPUE – Catch per unit effort for age 0 or juveniles
JUVPSD – Proportion of juveniles (≤ 200 mm) in sample
JUV%OCC – Proportional occurrence of juveniles among prime quality sampled sites

2014 Fishery Management Plan for Largemouth Bass in Maryland Tidewater Implementation Table			
Strategy	**Action**	**Date**	**Comment**
1.1 Annually conduct tidal bass surveys on targeted rivers, critically evaluate indices that are used to determine changes in the abundance, health, and life history of largemouth bass, within tidewater areas of the Chesapeake Bay watershed. Develop new indices as necessary.	1.1.1 Coordinate with regional managers to survey tidewater areas, and collect data needed to develop indices.	2014-2021 Continue	Similar to previous years, survey completed for 2021 (see Table 1 for survey results).
	1.1.2 Share results with anglers, stakeholders, and the general public via a Federal Aid Report, one-page summary sheets, an annual information booklet, and other forms as requested.	2016-2021 Continue	Black Bass Annual Review completed and online https://dnr.maryland.gov/fisheries/Documents/BBAR.pdf Two one-page outreach reports were distributed to over 50 tournament directors and 200,000 black bass anglers. Federal Aid Report completed, but not provided online. Results of some surveys posted on the Tidal Bass Program's webpage.
	1.1.3 Discuss indices with members of partner agencies, organizations, and universities to evaluate causes or consequences of changes in the indices.	2017-2021	Presented the results to the BBAC that reports to the Sport Fisheries Advisory Commission. Indices were discussed with the Virginia DWR, DOEE, and DNREC.
	1.1.5 Improve sharing of data with other MD DNR biologists and programs, such as the Blue Infrastructure Initiative and GIFS.	2016-2021	Critiqued GIFS; improved data sharing with GIFS by updating fish health information. An Inland Fisheries website was developed and linked to the Tidal Bass Program page to provide greater cross-referencing with other inland fisheries. Spatial layers added to the online database include those related to fish forage and catch from the surveys. An online data export portal was created so that the general public may query spatial data from the Tidal Bass Program.
1.2 Annually assess data quality, and effective usefulness of data collection.	1.2.1 Conduct general assessments of variance within catch and other indices, and ensure variance is considerably lower than the average point estimate.	2014 2019- 2020	Coefficients of variation (CV) for indices computed to assess, evaluate and determine if any were too high to yield productive indices; CVs ranged between 2% to 65%, with the most variable for catch indices; none varied beyond reasonable expectations (i.e., greater than 100%). Computation of indices using R-code provides variance estimates that are simultaneously examined with indices.
	1.2.3 Allow internal and external peer-review of data collection and analysis to refine methods based on expert opinions.	2015-2021 Continue	Two papers were published in 2014-2015. One article was published in 2017, and describes problems with the Potomac River bass fishery. The methodology of the publication contained analyses and data collection methods that were critiqued and improved by reviewer comments. Methods were described during stakeholder meetings to encourage feedback. An SOP was drafted and is reviewed by regional managers each year; the procedure is also available online for public consumption.
	1.2.4 Deliver technical reports to regional managers, other internal reviewers, and reviewers of refereed journals for review of methods and data analysis.	2016-2021 Continue	Federal Aid Report and the Black Bass Annual Review were provided to regional managers and senior staff for internal review.

	1.2.5 Assess and/or improve sampling equipment for efficiency.	2017-2018	QA/QC checks are routinely performed on datasets after they are entered into the GIFS database each year. Procedures for review were developed in 2018. Regional managers and the Tidal Bass Program discussed, and decided upon a routine maintenance schedule for boat electrofishers. Additionally, an oscilloscope was used to detect power output for eastern region vessels, which was also done in the southern region in 2014-2015 to ensure there was sufficient power output. Data is collected during the survey by completing a spreadsheet using an iPad. The data entry tabs include automatic QA/QC checks, and provide easy single file import to GIFS, thereby reducing data entry mistakes, and increasing speed by which data is entered.
2.1 Establish biological reference points for populations of tidewater largemouth bass, and use them to assess population status.	2.1.1 Compute 25th and 75th percentiles for each index from the reference dataset, which will be annual averages computed across a minimum of 10 years of data.	2014-2021 Continue	Reference points were re-evaluated and readjusted in the 2014 Tidal Bass FMP and for the 2017 Tidal Bass FMP. Reference points were updated for 10-year datasets available for Choptank River, Wicomico River, Patuxent River, Marshyhope Creek, Potomac River, and the upper Chesapeake Bay. The 10-year baseline dataset for Pocomoke River was completed in 2020.
	2.1.2 Obtain additional data for populations surveyed less than 10 years and develop reference points.	2016-2021 Continue	Data were collected from the Gunpowder River, Middle River, Bush River, and Chester River to assist creation of a 10-year baseline and provide reference points. Data collection from Sassafras River is planned to begin for 2022 or 2023.
	2.1.3 Use reference points from the peer reviewed literature, when possible, as comparisons to reference points, particularly for populations that do not have a reference dataset of at least 10 years.	2014-2021 Continue	Reference points from the peer reviewed literature were used to assess populations without a 10-year reference dataset.
	2.1.4 Adjust reference points as additional data are required for inter-correlations and importance in reflecting the status of populations.	2016-2020	Reference points were developed for Marshyhope Creek and revised for other rivers, based on 10 years of surveys beginning in 1999.
2.2 Compare current indices to the reference points, and assess significant differences between current indices and historical reference points.	2.2.1 Evaluate indices relative to all available reference points and historical data to determine which reference points describe a problem with the fishery.	2016-2021 Continue	For the annual population assessment, indices were compared for significant differences between current indices and historical reference points.
	2.2.2 Develop a management strategy for imperiled populations by constructing a framework of management actions for improving indices.	2016-2021 Continue	Management actions were evaluated to help improve the Potomac River fishery and the upper Chesapeake Bay fishery. Public input was received on various action options. Catch and return areas were not deemed valuable by the Black Bass Advisory Committee. Additional strategies such as targeting black bass anglers with conservation materials and developing reef habitat in the Potomac River occurred.

			Additionally, MD DNR stipulated and revised requirements on permits issued during warm water weather as well as worked with BBAC to promote catch-photo-release style tournaments during summer.
	2.2.3 Conduct population modeling to determine if, and how, management actions will influence indices and the population.	2014-2015 2019-2021 Continue	Spatial modeling was conducted in 2014 to determine how catch-and-return areas would influence populations of largemouth bass in the Potomac River and upper Chesapeake Bay. Assessments were conducted to evaluate existing spring-time regulations in tidal and non-tidal water and the expectations on their expansion to improve the fishery. Population modeling was utilized to explore the relative roles of recruitment versus exploitation on a population, and to evaluate the limits of management options in recruitment- limited systems. Spatial aspects of habitat quality in the upper Chesapeake Bay were included in population modeling efforts to examine relative roles of habitat and human behavior on outcomes of various management actions to protect the population.
2.3 Establish reference points for angler exploitation of largemouth bass populations in tidewater.	2.3.1 Coordinate with directors of competitive events to obtain information on catch and initial mortality of largemouth bass.	2017-2021 Continue	Directors who did not report findings were contacted by Email and/or phone to obtain reports resulting in more than 75% participation. As more tournament directors become aware of the permitting process, continued outreach on reporting is necessary. Additionally, all permits delivered by email included a reminder to report with the website address.
	2.3.2 Promote registration and activity reporting of tournament directors, for communication and compliance of permit restrictions.	2017-2018	A letter was issued to past and current tournament directors that reminded them of the obligation to get a free permit, and the requirements of the permit (i.e., reporting requirements, no leaking bags).
	2.3.3 Report results during an annual or semi-annual bass roundtable meeting that includes participants from tournaments and the recreational angling community.	2017-2021 Continue	Results are presented at the BBAC.
	2.3.4 Perform angler creel surveys, as necessary, to determine angler satisfaction, catch, and harvest rates by recreational anglers.	2017-2021 Continue	A statewide creel survey was developed as an online Volunteer Angler Survey. The online survey was advertised at two state parks (Smallwood State Park, Gunpowder State Park) as well as via press releases. As an incentive, anglers who take the survey may win a raffle. The survey website was revamped to make it more mobile friendly and provide greater developer control to efficiently make web-based changes, as needed. An angler-intercept creel study was conducted at access points on Potomac River in 2022 to calculate catch and harvest rates by recreational anglers. Datasets have been evaluated for their utility (USFWS; Chesapeake Catch, Angler's Log, MRFS), but most of these cannot be used for tidal freshwater habitats. In 2017, an intercept survey was completed to provide angler creel data that is comparable to past survey data from the 1980's and 1990's for Potomac River and upper Chesapeake Bay fisheries.

	2.3.5 Produce studies and provide guidance on live well operating procedures to reduce mortality of largemouth bass.	2017 -2020 Continue	Reviewed and updated guidelines on live release and handling tips in the Maryland Fishing Guide. Additional work was done to obtain information from B.A.S.S. Bass conservation videos are available online, advertised in the fishing guide, and advertised through email lists. Outreach was generated from research on keeping adult largemouth bass alive in live wells at Mississippi State University. Requirements on existing permits for tournament directors were clarified to help reduce handling stress on adults. Studies on the effects of piercing culling devices on bass were concluded, and information was sent to nearly 50,000 anglers via the Black Bass Annual Review. A Bass Class and Director's Black Bass Conservation Award were developed to help increase awareness of handling strategies and improve tournament infrastructure. Updated handling strategies identified in BassCare 101 (produced by AFTCO for B.A.S.S.) were disseminated to over 120 tournament directors and uploaded to MD DNR's tournament webpage. A new Bass Conservation webpage was created in 2020 to help convey the most relevant information directly to anglers interested in bass conservation.
3.1 Identify valuable habitat and habitat conditions for largemouth bass, and promote their protection.	3.1.1 Refine the habitat suitability index using important habitat variables for identifying and prioritizing suitable habitat for largemouth bass.	2016-2017	Spatial data on watershed quality were obtained from MD DNR Fisheries Habitat and Ecosystem Program. These data were loaded to an online spatial database of suitable areas for largemouth bass. This database is accessed at: https://dnr.maryland.gov/fisheries/pages/conserve-bass.aspx
	3.1.2 Ensure that the most informative variables are being measured during the Tidal Bass Survey by conferring with MD DNR Fisheries Habitat and Ecosystem Program.	2016-2017 2019-2020	The datasheet was submitted to Resource Assessment Services and the Fisheries Habitat and Ecosystem Program for internal review. Variables measured to assess fish health were examined by fish health experts within MD DNR; after consensus with program staff, these variables were included on datasheets and added to GIFS for long-term storage.
	3.1.3 Use a habitat suitability index, and consult anglers and regional managers to identify habitats important for the spawning success and growth of largemouth bass.	2015	Suitability of spawning coves were identified for several tidal rivers, and an ArcGIS shapefile was created to illustrate the coves. The work was written up, and was published in fall 2015 by the American Midland Naturalist. It conveys how coves were ranked according to their ability to support largemouth bass reproduction.
	3.1.4 Consult published literature and experts to help identify valuable habitat for spawning success and growth of largemouth bass.	2016-2017	Published literature on spawning habitat for largemouth bass was summarized for stakeholders who are evaluating whether catch-and-return areas are viable options for promoting reproduction. Literature was reviewed and processed, presented to the BBAC and is available at http://dnrweb.dnr.state.md.us/fisheries/calendar/events/1244/Meeting_BBAS_Aug_9_Presentation.pdf
	3.1.5 Generate and submit to GreenPrint spatial data reflecting valuable habitats for largemouth bass and anglers.	2018-2019	Spatial data highlighting important spawning areas were provided to MD DNR's Environmental Review team. This team reviews projects proposed by the general public. Because the projects could affect aquatic habitats, the review team will

			provide time of year restrictions when the project is proposed to impact a spawning area.
	3.1.6 Consider the effects of climate change on largemouth bass habitat, and develop adaptive management to address possible changes.	2015-2016 2019-2020	The impacts of sea level rise on nursery habitats of largemouth bass was investigated, and will be published in the American Midland Naturalist in fall 2015. While some nursery habitats in the Potomac River and the upper Chesapeake Bay will be negatively affected by sea level rise, the fisheries may be robust to changes, because the species is likely to expand its range as water temperatures warm. A spatial layer of spawning coves and potential impact by sea level rise was added to the Tidal Bass Program's website. Additional work to examine how changes in habitat carrying capacity, via climate change scenarios, affect fishery management was performed and is being prepared for submission to a peer-reviewed journal.
	3.1.7 Utilize the proposed Climate Sensitive Areas for use in land-use planning and increased protection of vulnerable habitats especially in regards to largemouth bass habitat.	2019-2020	Work was done to identify aquatic habitats that would be most susceptible to rising water temperatures owed to climate change in tidal waters. These areas could constitute climate sensitive areas.
	3.1.8 Provide comments during permit review via the MD DNR Environmental Review to help minimize ecological impacts on populations from tidewater of the Chesapeake Bay watershed and largemouth bass habitat.	2015-2020 Continue	The Tidal Bass Program worked with MD DNR’s Environmental Review team to review consequences, and draft a letter regarding MD DNR's position on coal ash discharge into the Potomac River from a Virginia business, Dominion Power; provided comments regarding construction projects proposed or conducted in the upper Choptank, Pocomoke and Wicomico Rivers. Comments were provided regarding a large- scale bridge project in the lower Susquehanna River.
	3.1.9 Write letters on official letterhead to stakeholders, or on behalf of stakeholders, to acknowledge and promote the significance of the fishery.	2017-2020 Continue	Official letters were written to tournament directors who target black bass in Maryland. A short presentation (handout) regarding the significance of the tidewater fishery was presented to the Sport Fisheries Advisory Commission.
	3.1.10 Promote a level of imperviousness that is lower than 10% of the drainage	2016	A map indicating watershed health, in part based on imperviousness levels, was added to an online spatial database of important bass habitats.
	3.1.11 Ensure that natural variability in stream discharge is maintained by encouraging "smart growth" and limiting channelization.		No work was done on this action.
	3.1.12 Encourage lower levels of nitrogen and phosphorus waste from entering waterways via non-point and point sources.	2014-2021 Continue	Letters were written in 2014 regarding eutrophication of Wicomico Rivers. In 2015-2016, reviewed grant proposals for nutrient and sediment reduction from public and private lands. Provided comments on removal of nutrients from storm water for 2 State Highway projects on Route 40 at the Gunpowder/Little Gunpowder.

	3.1.13 Proactively work through a comprehensive renewal process plan to identify and protect important habitat features.	2015-2016	Reviewed and commented on the proposed Mallows Bay National Marine Sanctuary. The focus was to ensure that angler access to Mallows Bay would not be negatively impacted by the "Sanctuary" classification. We were ensured that anglers would retain full access to the water.
	3.1.14 Collect data on invasive species as habitat data is collected in order to better monitor changes in habitat conditions over time, and evaluate how those changes would affect the largemouth bass fishery.	2016-2020 Continue	Data for invasive snakeheads were collected as part of the Tidal Bass Survey, which is on-going; these monitoring data were presented at a USFWS interagency taskforce to discuss impacts of snakeheads in January. Blue and flathead catfish are also considered invasive species. The commercial harvest of blue catfish has helped lower the biomass of blue catfish in some regions of the watershed**.** Studies on expansion and impacts of invasive species on largemouth bass were discussed during taskforce meetings and meetings with stakeholders at the First International Snakehead Symposium and local group meetings. Reviewed and provided assistance to remove invasive species from fish lifts at Conowingo Reservoir, which provides one of the most popular smallmouth bass fisheries in Maryland.
3.2 Improve habitat conditions for largemouth bass, and species on which largemouth bass depend.	3.2.1 Identify and determine the need for protected areas that are completely or temporarily closed to largemouth bass fishing either year-round, or during the spawning season, to prevent displacement or high levels of catch-and-release mortality.	2016-2020	Public awareness on the importance of SAV for productivity of largemouth bass was discussed at PRFC's inter-agency meeting in November 2015. A comprehensive review of existing spring-time and year-round possession restrictions was conducted, and that information was used to generate several internal reports. A report was presented to the BBAC. http://dnrweb.dnr.state.md.us/fisheries/calendar/events/1244/Meeting_BBAS_Aug_9_Presentation.pdf The committee decided that there was not enough evidence to support closures or catch-and-return areas as tools to protect black bass populations. http://dnrweb.dnr.state.md.us/fisheries/calendar/events/1277/Summary%20of%20Motions%20and%20Actions%20Sept%202016.pdf Additional work was done to create a spatially dependent demographic model that can be used to examine various management scenarios, such as catch-and-release areas; the work indicates that these areas would be less beneficial for an investment than protecting habitat or supporting restoration or habitat creation.
	3.2.2 Use ecosystem-based management to provide management options that protect growth or survival of largemouth bass, and accounts for competition or predation by invasive species.	2017-2018	Impacts of increasing abundance of invasive fishes (blue catfish, northern snakehead) were assessed in regard to increased competition and predation of largemouth bass. Harvest of invasive fishes has been encouraged. A forage fish index was developed to help document availability of forage for largemouth bass. Management options to improve forage fish abundance and diversity have not been developed, but work to protect the availability of SAVs for forage fish is being developed with Resources Assessment Services.
	3.2.3 Tidal Bass Program staff may work with Artificial Reef Program staff (MARI) as needed, to develop reefs and other artificial habitat for largemouth bass.	2016-2017 2019-2020	An artificial reef ball project was completed for Smoots Bay (National Harbor). Another reef project near Wades Bay in Potomac River proposed by bass anglers was reviewed internally and supported by MD DNR.

	3.2.4 Develop innovative storm water management techniques, promote storm water management retrofits where applicable, creation of wet marshy conditions throughout. watersheds, and reconnect streams to riparian areas.		No work was done on this action.
	3.2.5 Upgrade and improve semi-natural landscape elements, such as man-made wetlands, ponds, and recreated natural lands.	2019	Engaged in early discussions to help augment restoration at Cowpen Creek with submerged wooden reef habitat. Work has been indefinitely postponed to allow native grass bed restoration.
	3.2.6 Promote low sedimentation of streams.	2016-2017	Reviewed and commented on several projects that promoted low sedimentation of streams.
4.1 Generate a decision making process to resolve identified problems with the population and fishery, as they relate to significant departures of indices from reference points.	4.1.1 Hold public meetings to determine angler behavior and perceptions on the quality of the fishery.	2016-2021	Webinar meetings have been held annually for upper bay tournament directors (2016-2021). A total of twenty-four meetings have been held with BBAC.
	4.1.2 Evaluate the adequacy of current regulations in supporting the sustainability and quality of the fishery.	2016-2017	Catch and return areas were evaluated in 2014 and early 2015. Current possession regulations were also evaluated by MD DNR staff to determine what changes may be made to improve the sustainability of the Potomac River and upper Chesapeake Bay fisheries. These possession restrictions included fishable slots, catch-and-release areas, and closed areas. Past regulations such as a 15" limit during spring were evaluated for effectiveness.
	4.1.3 Establish relationships between fishery independent data, angler catch, and angler satisfaction.	2017-2018	The relationship between angler catch and satisfaction to previous studies and fishery independent catch data indicated that top targets remain black bass for upper Bay and Potomac Fisheries, despite decades of change in the fisheries and changes in relative abundance. Anglers remain satisfied with fishing, though concerns were raised regarding access to the fishery as well as restrictions (licensing, regulations).
4.2 Enhance fish populations by releasing hatchery-raised largemouth bass, when natural reproduction or recruitment is deemed insufficient for sustaining a fishery.	4.2.1 Target tidewater areas that require stocking of largemouth bass that are determined to be at risk, and would be expected to suffer a decline in the quality of the fishery, without stocking efforts.	2017-2021 Continue	Stocking is a routine annual event guided by a stocking policy. https://dnr.maryland.gov/fisheries/Documents/Tidal_Bass_Stocking_Policy.pdf To build the fishery in Baltimore County, MD DNR is investing money in stocking fish from outside of the state, as well as releasing some fish spawned from the Potomac River stock. Stocking in Gunpowder River and Middle River has helped support a growing fishery in those systems. Stocking records are routinely updated online. https://dnr.maryland.gov/fisheries/Pages/bass/bass_stocking.aspx
	4.2.2 Generate a stocking strategy with an objective to either support or improve the fishery	2016-2018	In accordance with the stocking policy (2015), key areas were identified for stocking and include Potomac River, Middle River, and the upper Chesapeake Bay. An objective method of prioritizing stocking areas was appended to the stocking policy in 2016. The stocking policy has been shared online and with hatchery staff. Money

			was requested and obtained from federal aid to purchase largemouth bass juveniles when stocking to an environment from which brood stock are not obtained.
4.3 Promote the survival and abundance of older, larger fish.	4.3.1 Adjust creel limits or size limits for promoting survival of older fish when: 1) there are few adults in the population for enabling sufficient recruitment that sustains the population; or b) catch rates for adults are too low to provide a quality fishery.	2016-2018	Permitted tournaments in Potomac River and upper Chesapeake Bay were provided either the option to limit creel of large older fish, or to implement strategies that better secure their safety. Most directors selected the latter option. However, some directors have voluntarily lowered creel limits during July and August (warm weather months), as measured by a directors' selection of best management practices when filing for a permit.
	4.3.2 Improve and promote angler awareness that increases survivorship of largemouth bass during catch-and-release fishing.	2016-2019	Provided funding and in-kind support for research on keeping adult largemouth bass alive in live-wells at Mississippi State University. Black bass anglers were targeted with current information on reducing handling stress of bass that anglers intend to keep alive in February and June. Work began on a Bass Conservation website and the existing website was reworked to improve efficiency in delivering information.
	4.3.3 Engage in meaningful studies that benefit the angling community by informing them on methods to improve survivorship.	2017-2018 2019-2020	Began study to examine the effects of piercing culling devices on largemouth bass feeding and infection susceptibility. This work was concluded and reported to anglers via Black Bass Annual Review. Work regarding live well maintenance was synthesized and used to refine guidelines in the Guide to Fishing and Crabbing in Maryland, and help support development of the online Bass Class. Additional work was completed to refine existing live well best management practices offered by MD DNR in 2020, with a new video produced and provided online and as part of MD DNR’s virtual bass class.
	4.3.4 Enforce restrictions on holding more than 5 bass/angler/day by specially permitted release boat captains.	2016-2021 Continue	Tournaments with release boats were attended by staff. Oxygen and temperature conditions required in the permit were measured by MD DNR staff. When problems occurred, they were solved by the release boat crew and MD DNR staff. Staff developed a datasheet to record oxygen and temperature routinely throughout the day; the max and min are provided by the tournament director at the end of the day to aid in their data reporting.
	4.3.5 When necessary, discourage the transportation of largemouth bass among river systems or to an uninterrupted area greater than 30 km from its area of capture.	2016	Limiting redistribution of fish from distant streams was encouraged as a best management practice in the permitting system for most black bass tournaments in Maryland.
4.4 Protect, enhance and improve important angler access points to the tidewater largemouth bass fishery.	4.4.1 As part of the Chesapeake Bay Watershed Access Plan, 300 public access sites will be developed in the watershed and important angler access points to the tidewater largemouth bass fishery should be provided.	2016-2017	An angler access map describes fishing spots for anglers in Maryland. It was referenced in phone calls and conversations with stakeholders throughout the year. Mallows Bay is considered as a national marine sanctuary and if approved, will be advertised as a valuable access point to the tidewater largemouth bass fishery on Potomac River. Hallowing Point, Cedar Point, and a new free fishing area in Federalsburg (see Action 4.4.4) were added or edited in the angler access map.

	4.4.2 Determine crowding of angler access points and mitigate, when possible.	2017-2018	Crowding of black bass anglers at Conowingo Reservoir was raised as an issue by tournament directors. As a result, Exelon will be expanding the parking lot in the near future. Parking and access for the BASS event in Harford County was discussed with staff from Flying Point Park.
	4.4.3 Encourage public or DNR Fisheries to identify potentially new access areas for motor boats.	2017-2018	The safety concerns associated with mooring boats at Rogues Harbor (Elk Neck State Park) has been noted for years. The Maryland Park Service met with Fishing and Boating Services to consider engineering plans to improve safety and access for motorboats to this important portal to the Upper Bay bass fishery.
	4.4.4 Create and/or advertise new angler access points to the tidewater largemouth bass fishery.	2015-2016	The Angler Access map, which is available online, was noted in correspondence with several anglers who were interested in fishing in Maryland; also, a map of approved release sites for tournaments is available online, advertised to directors, and is used to highlight access points for competitive sport fishing. Reviewed and commented on two Project Open Space (POS) projects with the potential to increase angler access to tidal bass waters. Hallowing Point on the Calvert County side of the Benedict Bridge is being expanded to include additional boat launches, shoreline fishing and, possibly, a fishing pier. Cedar Point Wildlife Management Area will expand waterfowl access to hunters in southern Charles County, but there will be ample shoreline access for anglers as well.
	4.4.5 Promote small craft and shore-based angler access.	2016-2017 Continue	Worked with the Town of Federalsburg to create a new "free fishing area" along Marshyhope Creek. All POS submissions that are received in the Southern Region office are reviewed with additional angler and boat access being the primary points of interest.
5.1 Improve habitat for largemouth bass.	5.1.1 Control and manage invasive species that threaten the health or sustainability of largemouth bass populations.	2016-2021 Continue	Incentive programs, such as the statewide invasive species record, were promoted to help control and manage invasive species (Northern snakehead). A fishing derby aimed at raising awareness of northern snakehead was held in partnership with the National Park Service and U.S. Fish and Wildlife Service in C&O Historical Park. A fishing derby was held at Harriet Tubman State Park in 2019 and Gunpowder State Park in 2021 and 2022. Work to examine changes in fish community structure at Blackwater Refuge helped address impacts. Consumption rate studies for Northern snakehead have been completed with the data published in Transactions of the American Fisheries Society.
	5.1.2 Monitor, protect or enhance the availability of prey for largemouth bass by partnering with other agencies or other programs within MD DNR.	2015	A monitoring strategy was implemented within the Tidal Bass Program for documenting the availability of prey. Availability of forage was investigated in Middle River by developing a fish forage index, which was computed from Tidal Bass Program data in select streams and spatially referenced online using ArcGIS.
	5.1.3 Control or limit pollution sources to impaired waterways in order to improve the	2017-2018	A habitat subgroup of the BBAC was formed to work with MD DNR, and identify potential projects or legislation that should be supported or commented on by the black bass fishery. A liaison to the committee was identified and will work with MD DNR to address pollution problems in tidal bass fishery habitats. A new app, Water

	sustainability of largemouth bass populations.		Reporter, was explored as a mechanism for the general public to report pollution problems to the liaison and MD DNR/MDE.
5.2 Maintain important aspects of ecosystem function to maintain habitat for largemouth bass. Continue 5.2	5.2.1 Identify components of ecosystem function essential for the sustainability of largemouth bass populations.	2016-2017 2019-2020	A macroinvertebrate index of biotic integrity was developed and compared between *Vallisneria* (eelgrass) dominated habitats and *Hydrilla* dominated habitats. This index reflects the diversity of the macroinvertebrate community that may be reflective of habitat quality. Additional components of spawning areas have been examined and published online and in the primary literature.Work to address the value of submerged grasses has been published, but little work has been done to determine how other components (i.e., forage fish, submerged artificial structure) influence the growth and reproduction of populations. Work to quantify the availability of forage fish was completed in 2019, and new data streams quantifying the availability of submerged wood was completed in 2020. These new variables were identified as important components of ecosystem function for the sustainability of largemouth bass populations.
	5.2.2 Identify possible threats to the maintenance and function essential for the sustainability of largemouth bass.	2016-2018	Ecosystem threats to the fishery in the Potomac River and upper Chesapeake Bay were largely identified as ones related to loss of SAV or submerged structure in tidal rivers. Threats to the sustainability of largemouth bass from coastal plain rivers of eastern shore and urbanized areas (e.g., Middle River) are not well-described, but could include road development, eutrophication and invasive species. The stocking has been identified as a method of maintaining the sustainability of largemouth bass. Additional work to understand fish kills, and the role of plankton in those kills, has been disseminated to the general public for the Middle and Gunpowder rivers.
	5.2.3 Preserve ecosystem components that are essential and potentially threatened.	2017-2018	Work was completed to establish the value of submerged structure in Mallows Bay as an important attractor for largemouth bass and the fishery. The area has been designated as a sanctuary by NOAA, and there was concern that the designation would either limit access to the fishery, or result in removal of the artificial structures.

Acronyms

BBAC – Black Bass Advisory Committee
C&O – Chesapeake and Ohio
DNREC – Delaware Department of Natural Resources and Environmental Control
DOEE – District Department of Energy and Environment
DWR – Virginia Department of Wildlife Resources
GIFS – Geographic Inland Fisheries Survey System
MARI – Maryland Artificial Reef Initiative
MD DNR – Maryland Department of Natural Resources
MDE – Maryland Department of the Environment
POS – Project Open Space
PRFC – Potomac River Fisheries Commission
QA/QC – quality assurance/quality control
SAV – Submerged Aquatic Vegetation
SOP – Standard Operating Procedure
USFWS – United States Fish and Wildlife Service